VIBRATION TEST EQUIPMENT

MODEL D22PM L

SERIAL NUMBERS 8948. 8949

MP MASTER
MA34548

UNHOLTZ-DICKIE CORPORATION

MODEL D22PM L

SERIAL NUMBERS 8948. 8949

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CERTIFICATE OF CALIBRATION

This document certifies that the Unholtz-Dickie Model D22PML Serial No. 8948, 8949 has been calibrated at the factory and met all technical specifications contained in the accompanying manual of Operating and Servicing Instructions at the time of shipment.

Anthony Graziuso
Calibration Engineer

DATE OF SHIPMENT: 1-21-88

Catalog Copies

1-21-88

OPERATING AND SERVICING INSTRUCTIONS

MODEL D22 SERIES

SIGNAL CONDITIONING AMPLIFIER

MODEL D22PM$_L$

SERIAL NUMBERS 8948, 8949

SUMMARY

CIRCUIT SCHEMATICS: A19766, B12362, C12496

F.S. TAPE OUTPUT: 0-10 V pk

F.S. GALVO OUTPUT: _____

L.P. FILTER (3 POLE) ±2% @ 3 kHz

-3dB @ 6 kHz

SPECIAL FEATURES: L

UNHOLTZ-DICKIE CORPORATION
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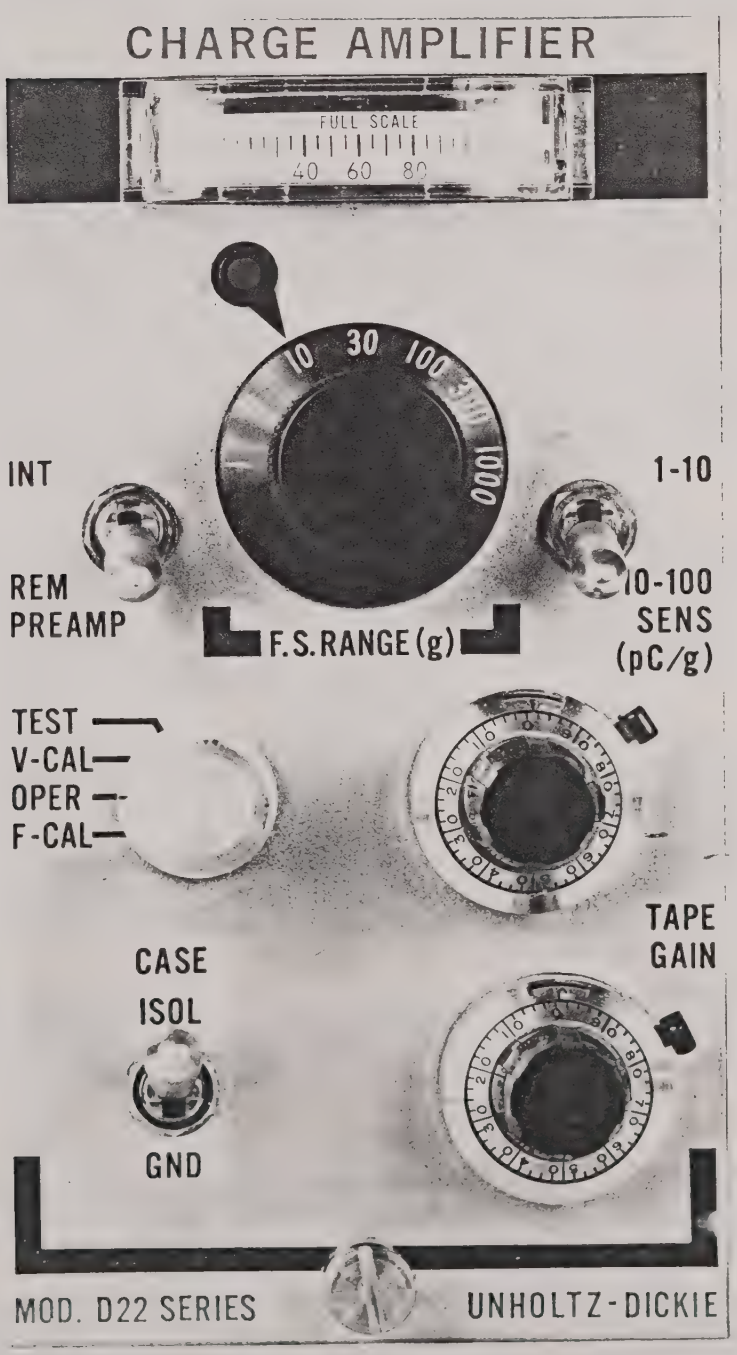
1. GENERAL DESCRIPTION

The U-D Model D22 Series Signal Conditioning Amplifier is a low-noise, solid-state, data-acquisition instrument. It generally supersedes the D11 Series instrument, and the provision of modular construction, a vinyl-clad case, self-contained power supply, and rear-mounted connectors make it equally suitable for single-unit bench operation or multi-channel rack mounting. The design makes extensive use of integrated circuits and plug-in circuit cards.

The D22PM is a basic charge amplifier which satisfies most general laboratory needs. The instrument accepts inputs from piezoelectric transducers to an internal charge converter or provides DC power to a remote two-wire preamplifier, and accepts the signal from the pre-amplifier. The remote preamplifier is either a Model 22CA-2 Charge Preamp or a Model 11PA-2 Voltage Preamp.

The D22 instrument includes a differential feature which permits separate ground systems for the amplifier input and output circuits. This allows the case of the input transducer to be grounded at the mounting location without introducing amplifier ground potentials at the signal output. This feature was pioneered in the earlier Model D11 Series instruments and has proven to be very useful for rejection of ground loop signals when the transducer case must be grounded.

The input signal is conditioned to provide higher level outputs required for monitoring and recording purposes. A variable-gain, range-switched output is suitable for tape recording, spectrum analysis, oscilloscope monitoring or other readout with full scale condition from 0 to 10 Volts peak.



Model D22PM Charge Amplifier

2. CONTROLS - CONNECTORS

The front panel controls are shown in Fig. 2.1 and the rear panel details are shown in Fig. 2.2. All two-position toggle switches are locking and must be pulled out to switch to the other position. The following descriptions are intended to cover all the standard features of the basic D22PM as well as the commonly-used servo and galvo options.

2.1 Front Panel Controls (Fig. 2.1)

2.1.1 SENSITIVITY RANGE SWITCH (1-10), (10-100). This two position toggle switch establishes the range for the sensitivity of the accelerometer being used. The units are pC/g, pC/psi, or pC/engrg unit, depending on whether the transducer is an accelerometer, pressure gage, force gage or other.

Full scale output ranges can be extended by a factor of ten in the lower direction by using an accelerometer in the 10-100 range and intentionally placing the range switch in the 1-10 position. All indicated full scale range values are then divided by 10.

Similarly, the full-scale output ranges can be extended by a factor of ten in the upper direction by using an accelerometer in the 1-10 range and intentionally placing the range switch in the 10-100 position. This is especially useful for high-g shock work and all range values are multiplied by 10.

2.1.2 SENSITIVITY DIAL. This ten-turn dial with locking brake and potentiometer is used to set the significant figures of the transducer sensitivity within the ranges indicated in 2.1.1. The dial can always be set between 1.0 and 10.0 and also somewhat above 10.0 and below 1.0 depending on the requirements of individual users. The setting and reading accuracy is about 1% at 1.0, and 0.1% at 10.0 (one-half of one small scale division).

If either the internal or external charge converter is used, the charge sensitivity in pC/g specified on the accelerometer data sheet is set directly on the SENS. dial and RANGE.

2.1.3 FULL SCALE RANGE. A rotary switch having the full scale range values engraved on the skirt of the knob. The switch has seven positions from 1 g to 1K g and the pilot light near the arrow indicates a power on condition.

2.1.4 TAPE GAIN. A ten-turn potentiometer with a direct reading turns-counting dial and locking brake, which varies the full-scale tape driver output from 0 to 10 V peak. Setting the TAPE GAIN at less than 100% (10 turns) causes a lower

full scale output but allows a larger overdrive capability without clipping at the tape output. For example a setting of 2.0 V pk will allow 5 times overdrive beyond full scale condition without clipping for all except the highest full-scale range position.

2.1.5 GALV. GAIN (Option G) A ten-turn potentiometer with a turns-counting dial and locking brake, with a function identical to that of the TAPE GAIN except that it applies to the GALV. output.

2.1.6 CASE ISOL.-GND. A two-position toggle switch which selects the proper mode of operation with accelerometers which have the case isolated from the test specimen or the case common to the electrical ground at the test specimen. When the transducer case is isolated, use the ISOL. position. When the transducer case is grounded, use the GND position.

The pilot light provides a convenient means for proper selection if the grounding condition is not known. The pilot light state chart shows the possible combinations.

Pilot Light State Chart (Condition)		TRANSDUCER CASE CONDITION	
		ISOL	GND
SWITCH POSITION	"ISOL"	ON	ON
	"GND"	OFF	ON

If the light remains on in both switch positions, choose the GND position for the switch. If the light is on only in the ISOL position, leave the switch in the ISOL position.

2.1.7 MODE SWITCH. A four-position rotary switch which selects modes of operation or calibration. The descriptions of the four positions follow:

TEST - The shield of the transducer cable is connected to the OSC input. The oscillator voltage is fed to the charge converter through the capacitance of the cable and transducer. This provides a check of the cable and transducer integrity (if the shield or case is not grounded) by producing an output that is proportional to the source capacitance. A reference reading with a known 1000 pF capacitance can be obtained by first using the V-CAL mode described in the next paragraph.

V-CAL - The OSC input is connected through a 1000 pF ±0.5% capacitor to the input of the charge converter. All outputs depend on the SENS. and F.S. RANGE SWITCH settings. A 1 pC/mV conversion is provided by the capacitor.

OPER. - The CHARGE input is connected directly to the charge converter and the OSC is disconnected.

F-CAL - The OSC input is connected so that the SENS. and F.S. RANGE settings are disabled and an input signal of 100 mV peak provides full scale indication for METER, GALV. and TAPE outputs.

The TEST and V-CAL positions are not operative when a REMOTE PREAMP is used. Calibration connections with the remote preamplifiers is shown in Figure 4.1.

2.1.8 PREAMP. REM. - INT. A two position toggle switch. The REM. position is used for either the Model 22CA-2 or Model 11PA-2 remote preamp. The INT. position is used when the transducer is connected to the internal charge converter in the Model D22 Series.

2.1.9 FILTER. The low-pass filter in the D22PM instrument may be removed by extracting the small plug-in capacitor board from card 12311 after the top-cover of the Model D22 has been removed. The sub plug-in board should be marked with the filter frequency (±2% point).

2.1.10 METER. The meter normally has a single scale calibrated in per cent of full scale from 0 to 120%. Dual meter scales (0-3 and 0-10) for exactly 10 dB range switching can be supplied when the 10 dB range switching option has been specified. The meter movement responds to the absolute average value of the input signal and the meter scale is calibrated in terms of the peak value of a sinusoidal input signal.

2.2 Chassis Screwdriver Adjustments

These potentiometer adjustments are made from access holes located on top of the chassis and are appropriately marked. Adjustment is generally made only during periodic calibration checks.

2.2.1 ACC - For instruments with the SERVO output (Option S) this trimming potentiometer is used to adjust the output calibration constant to 10 mV/g. This adjustment is made before the METER adjustment is made.

For the basic instrument with no SERVO or GALV outputs, the ACC adjustment is set so that the full scale tape output is obtained for a calibration signal corresponding to the full scale value indicated by the F.S. RANGE switch.

2.2.2 F-CAL - The MODE switch must be in the F-CAL position before this adjustment is made, and 100 mV peak is applied to the OSC input. The F-CAL pot. is adjusted for full scale output at the tape output.

2.2.3 METER - This adjustment is made to provide full scale meter deflection when a calibration voltage corresponding to the full-scale value indicated by the F.S. RANGE switch is applied to the OSC input.

2.2.4 OSC (Option O) - This adjustment is used to set the internal 100 Hz calibration oscillator signal to 100 mV peak. The internal oscillator signal can be monitored at the PATCH connector for this adjustment.

2.3 Internal Screwdriver Adjustments

These potentiometer adjustments can only be made by removing the top cover of the chassis. They have been carefully set at the factory and should only be readjusted if a malfunction is suspected. These adjustments are described for each printed circuit card.

2.3.1 DIAL-A-GAIN AMPLIFIER (PC BD12307) The BAL potentiometer is used to adjust the DC output of the card to a slightly positive voltage for a SENS. DIAL setting of 1.0 and no signal input. The voltage can be monitored on pin 8 when the bottom cover has been removed to expose the connector pins.

The CURR ADJ. potentiometer is used to set the constant current excitation for the remote preamp at 3.85 mA. This can be measured by placing a milliammeter across the REMOTE PREAMP input. With an RCA-2TR connected, the resulting bias voltage should be between 10-14 V DC. A BNC TEE may be used if the measurement is desired.

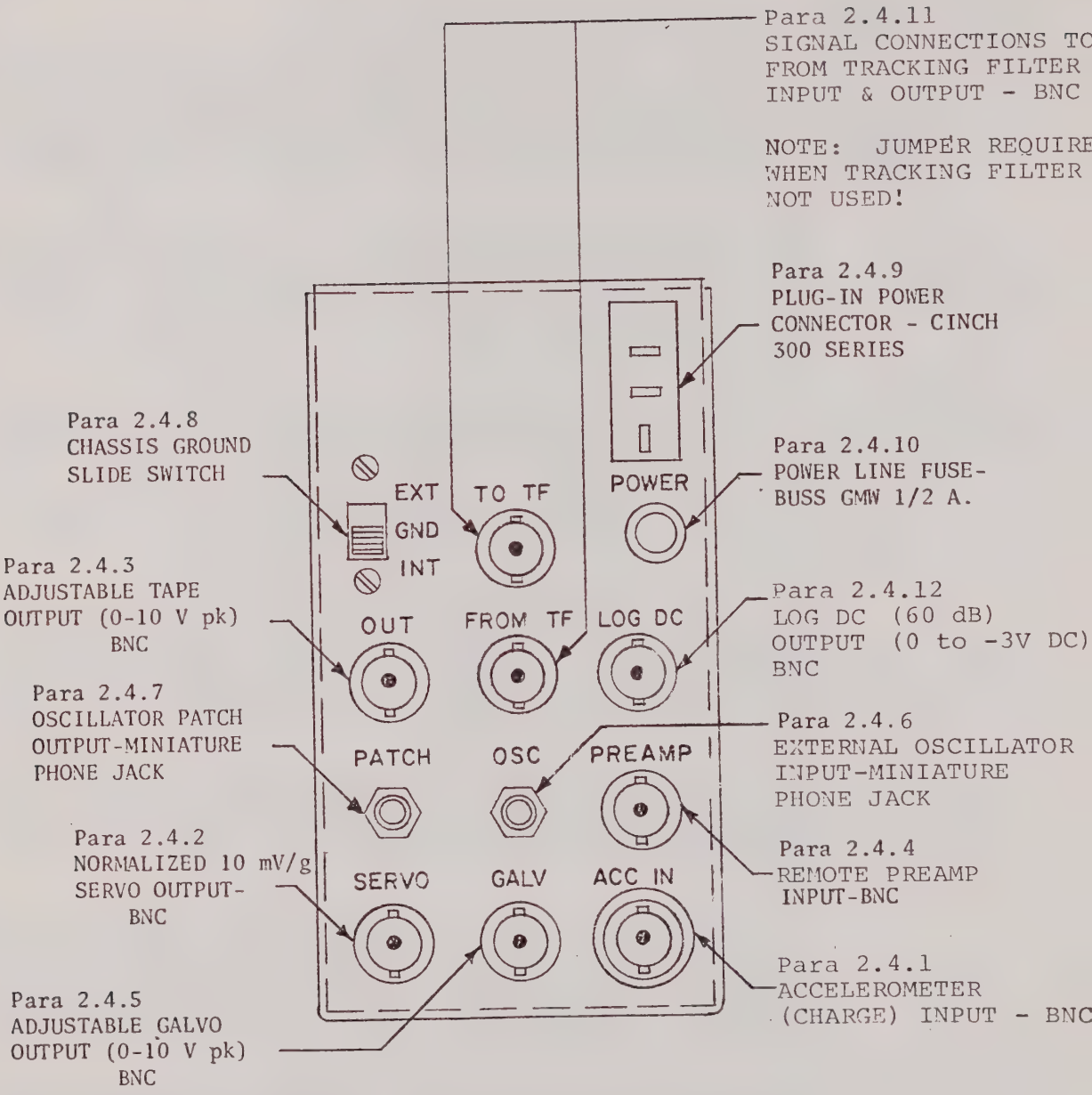
2.3.2 DIFF AMP. - L.P. FILTER - TAPE (PC BD12311) The NULL potentiometer is used to adjust the ACC output of the instrument to a minimum when a test signal is inserted between the shell of the ACCEL IN connector and the shell of the OUT connector. The CASE switch must be in the GND position. In this way rejection of ground difference potentials is accomplished.

The BAL potentiometer is used to adjust the DC voltage at the tape output to zero for direct coupling. The output may be monitored on pin 2, or at the rear OUT connector.

The GAIN potentiometer is used to adjust the tape output to the specified full scale value for a TAPE GAIN setting of 100%, and a calibration voltage input equal to the full-scale value indicated by the F.S. RANGE Switch. This adjustment is always made after the ACC adjustment for the SERVO (10 mV/g) is done.

2.3.3 SERVO-METER (PC BD12373) The BAL potentiometer is used to null the output of the first stage of the converter (point A) for zero signal input.

The ZERO potentiometer is used to null the output of the last stage of the converter (point B) after the BAL adjustment is made. These adjustments are critical only when wide-range DC outputs are needed.



REAR PANEL - MODEL D22PMGSLT

FIGURE 2.2

2.4 Rear Panel Features (Fig. 2.2)

2.4.1 ACC IN An insulated BNC connector for accepting the signal from a piezoelectric transducer. It is the input to the internal charge converter. A Microdot 33-101 adapter can be used to provide compatibility with low-noise cable and a Microdot connector. The PREAMP switch must be in INT. position.

2.4.2 SERVO (Option S) An insulated BNC connector providing an output voltage with the calibration constant of 10 mV/g.

2.4.3 OUT An insulated BNC connector providing an output voltage of 0-10 V pk for inputs corresponding to the full scale value indicated on the F.S. RANGE switch and a peak current limited at ±10 mA. The full scale output level is controlled by the front panel TAPE GAIN potentiometer.

2.4.4 PREAMP An insulated BNC connector for accepting the two-wire connection (shield and center conductor) to the Model 22CA-2 or Model 11PA-2 external preamps. This connector is active in the REM position of the front panel PREAMP switch.

2.4.5 GALV. (Option G) An insulated BNC connector providing an output voltage of 0-10 V pk for inputs corresponding to the full scale value indicated on the F.S. RANGE switch. The output current is limited at ±100 mA. The full scale output level is controlled by the front panel GALV GAIN potentiometer.

2.4.6 OSC A miniature phone jack for accepting an external calibration signal. If an internal oscillator (option O) is located within the module, it is automatically disconnected when the external signal is plugged into the OSC jack. A mating plug is supplied with the instrument.

2.4.7 PATCH A miniature phone jack for patching the calibration signal on to the next channel. The PATCH jack for channel #1 is connected to the OSC jack for channel #2, etc. The mating phone plug is Switchcraft TINI-PLUG #780 for both jacks. Patch cords are supplied with the instrument.

2.4.8 EXT GND - INT GND. A two position slide switch that connects the output circuit signal ground to the chassis in the INT GND position and leaves the signa ground floating in the EXT. GND. position.

If signal ground is common to chassis in the external instrumentation, the EXT. GND. position may generally be used. However, if the third wire in the power cord

is not carried to the power line ground at the socket and the chassis is not electrically common to other chassis in the system, the INT. GND. position should be used. The INT. GND. position should also be used if signal reference is not connected to chassis in the external instrumentation.

In a practical sense, the switch position should be used that shows the minimum amount of power frequency pickup with an oscilloscope monitoring the output(s) of interest.

2.4.9 POWER A three-pin connector which mates with the 22RA rack adapter power strip or the individual line cord.

2.4.10 FUSE - Bussman GMW 1/2A.

2.4.11 TO TF AND FROM TF - A pair of insulated BNC connectors provides buffered input and output connections for insertion of an external tracking filter such as the Unholtz-Dickie Corp. Model TF11 or TF22. The TO TF BNC is connected to the input of a tracking filter and the FROM TF BNC is connected to the output of the tracking filter. THESE BNC CONNECTORS MUST BE JUMPERED TOGETHER WITH CABLE SUPPLIED WHEN A TRACKING FILTER IS NOT BEING USED!

The nominal signal level is approximately 100 mV/g for the 1 g to 30 g full scale ranges, and is a nominal 3 V pk at full scale condition for the 30 g to 1K g full scale ranges. Calibration of the D22 Series instrument is performed with the jumper cable installed and it is assumed that the tracking filter gain when connected is unity (1.0).

2.4.12 LOG DC - An insulated BNC connector providing a DC output voltage proportional to the logarithm of the input amplitude. The calibration constant is 1.0 V/decade The 60 dB dynamic range applies from 100% of the selected full scale range to -60 dB down (providing the noise conditions are more than 60 dB down for the operating conditions involved). For convenience of plotting with an X-Y recorder, the output is zero volts at 100% full scale to -3V DC at 60 dB down.

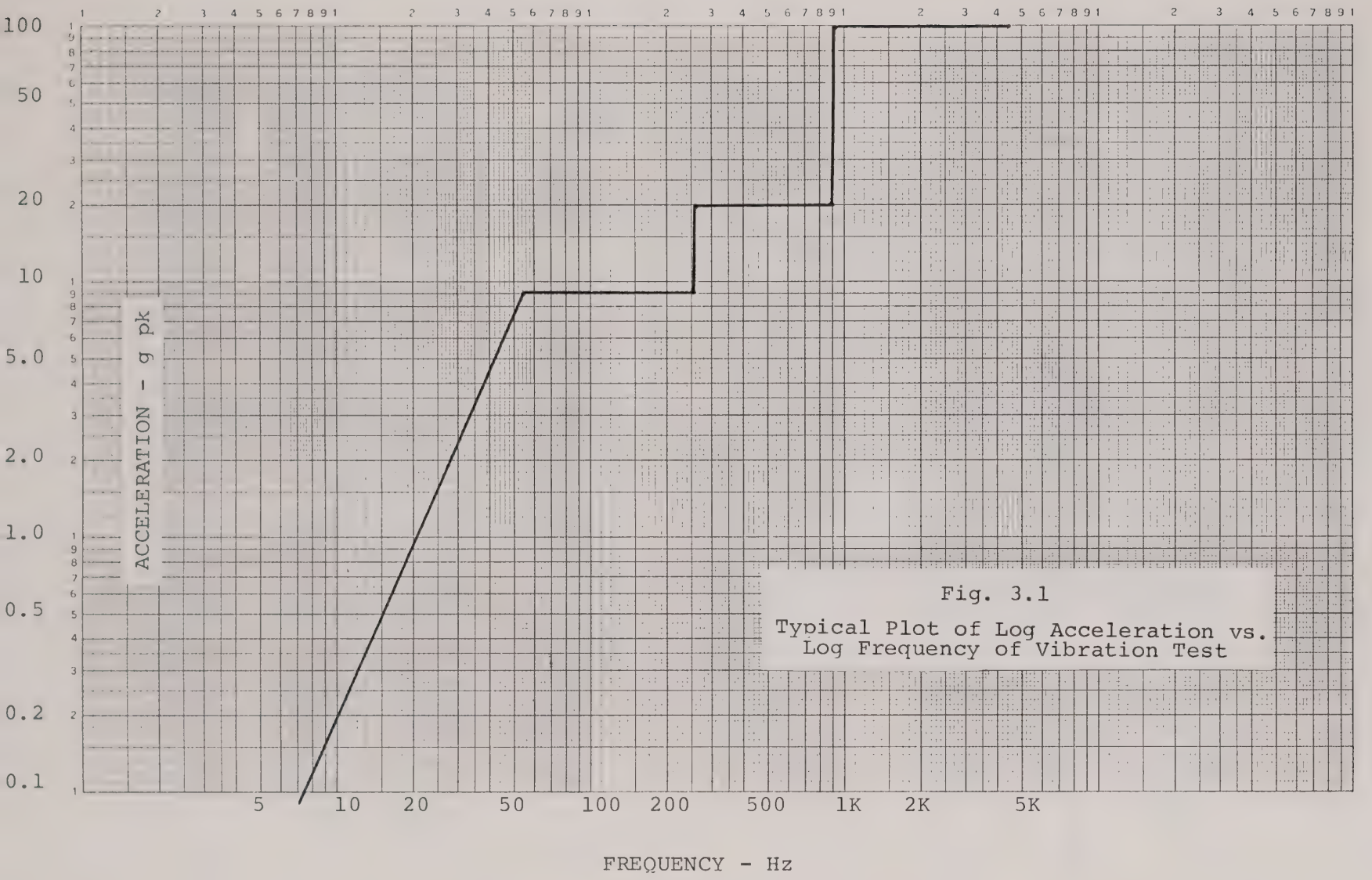


Fig. 3.1

Typical Plot of Log Acceleration vs. Log Frequency of Vibration Test

3. OPERATION

All toggle switches must be pulled out to switch.

3.1 General Procedure

3.1.1 Internal or Remote Preamp

Place the PREAMP switch on the REM position if the instrument is to be used with a remote two-wire preamp (Model 22CA-2 or 11PA-2) in the vicinity of the transducer. If there is a direct connection between the Model D22 and the transducer, use the INT position.

When the internal mode has been chosen, it is recommended that low-noise, subminiature microdot cable is used whenever possible. Connection is made to the ACC IN BNC by means of a Microdot 33-101 adapter (supplied by user). Standard RG/U cable instead of low-noise cable may be used, but extreme care in routing must be exercised, since it is often more than 100 times more sensitive to cable motion in generating electrical noise voltages (triboelectric effect).

When the remote preamp mode has been chosen, use standard RG/U cable or other two-wire cable to connect the remote preamp to the PREAMP connector. Cable lengths up to 2000 feet can be used between the remote preamp and Model D22 Series. The low impedance level of the driving source makes the circuit insensitive to cable motion.

3.1.2 Other Front Panel Settings

CASE - ISOL or GND See Section 2.1.6
SENS. RANGE - See Section 2.1.1 } Determined by Transducer
SENS. DIAL - See Section 2.1.2 }
F.S. RANGE - To range value greater than highest measurement expected

3.1.3 Filtering

Check the low pass filter condition stated on the manual front cover and title page as shipped from the factory. If changed by customer, make sure of the conditions of the low-pass filter sub plug-in board on PC CARD 12311. The filter is active when the small sub plug-in board containing three capacitors is installed. The customer may desire to mark the filter frequency at a convenient location on the front panel if the filter condition is changed periodically.

3.1.4 Output Connections

Connect the OUT, GALV and SERVO outputs to the readout or control equipment as required. See Section 2.4.8 for recommendation for setting the INT GND-EXT GND Switch.

3.1.5 Apply line power by plugging in the instrument individual line cord or by applying power to the Model 22RA Rack Adapter housing the instruments. Make certain the front panel pilot light is ON. If the light is not on, consult Section 2.1.6 and then check the FUSE.

3.1.6 Adjust the TAPE GAIN and/or GALV GAIN as required. Remember that the dial setting provides a calibrated full scale output in terms of AC volts pk. For instance a setting of 1.00 provides 1.0 V pk at full scale conditions.

3.1.7 Monitor and record test data as required.

3.2 Full Scale Output Check

3.2.1 Patch all channels to the channel with the internal oscillator (master) by connecting the PATCH jack of the master channel to the OSC jack of the next channel and continue this connection from channel to channel. If the internal oscillator is not present, designate channel #1 as the master channel and apply 100 mV peak at 100 Hz to the OSC jack of that channel. Six channels can be supplied from one channel with an internal oscillator (Option O).

3.2.2 Set MODE SWITCH to F-CAL
TAPE GAIN to desired value (Section 2.1.4)
GALV GAIN to desired value (Section 2.1.5)
Monitor desired outputs

3.2.3 Apply line power and allow at least a minute for warmup.

3.2.4 Check outputs for expected values.

3.3 Integrity Test For Input Cable and Transducer

This test can be carried out when the transducer is operating with the internal charge converter and when the transducer case is ISOLATED from ground at the mounting location.

3.3.1 Provide the following connections and settings:

Connect input transducer (Section 2.1.1)

Provide 100 mV peak at OSC jack if option O is not available.

SENS. to 10.0
F.S. RANGE to 10
MODE to V-CAL

Apply power, allow at least a minute warmup.

3.3.2 Determine the full scale output at the OUT BNC, GALV BNC, or the meter indication (O_{FS}).

3.3.3 Switch MODE to TEST. Record OUTPUT (O_T) and F.S. RANGE (R_T). It may be necessary to change the range.

3.3.4 Total capacitance of cable and accelerometer is given by:

$$C_C + C_a = \frac{R_T \times O_T}{10 \times O_{FS}} \times 1000 \text{ pF}$$

3.4 Log DC Calibration (Option L)

3.4.1 The log DC output is usually used to plot acceleration amplitude vs frequency as in Fig 3.1 on a X-Y Recorder. With two Model D22 Series instruments ratios of two accelerations or of acceleration and force may be plotted.

3.4.2 Provide either log-log paper (2 x 3 or 3 x 5 are commonly used), or semilog paper (3 log x 70 linear) for recording. Place the graph paper on the X-Y recorder, align the paper and actuate the chart hold feature.

3.4.3 Connect the LOG DC output from the D22 instrument to the (+) and (-) Y recorder input. If the D22 channel does not have its own internal oscillator, patch or connect a 100 mV pk, 100 Hz sine input to the OSC mini phone jack.

3.4.4 Place the D22 instrument SENS Range Switch on (10-100), SENS Dial at 10.0, F.S.R. Switch at 1 "g" and the Mode Switch to V-CAL. This should produce a 100% full scale meter indication and zero Volts DC at the LOG DC output.

3.4.5 Actuate the recorder servo feature and adjust the Y-ZERO control to locate the pen at the top line of the graph paper. This will represent 100 g or whatever full scale range is required for the test to be performed. Remove the Y input connection momentarily to verify that the input is essentially zero volts.

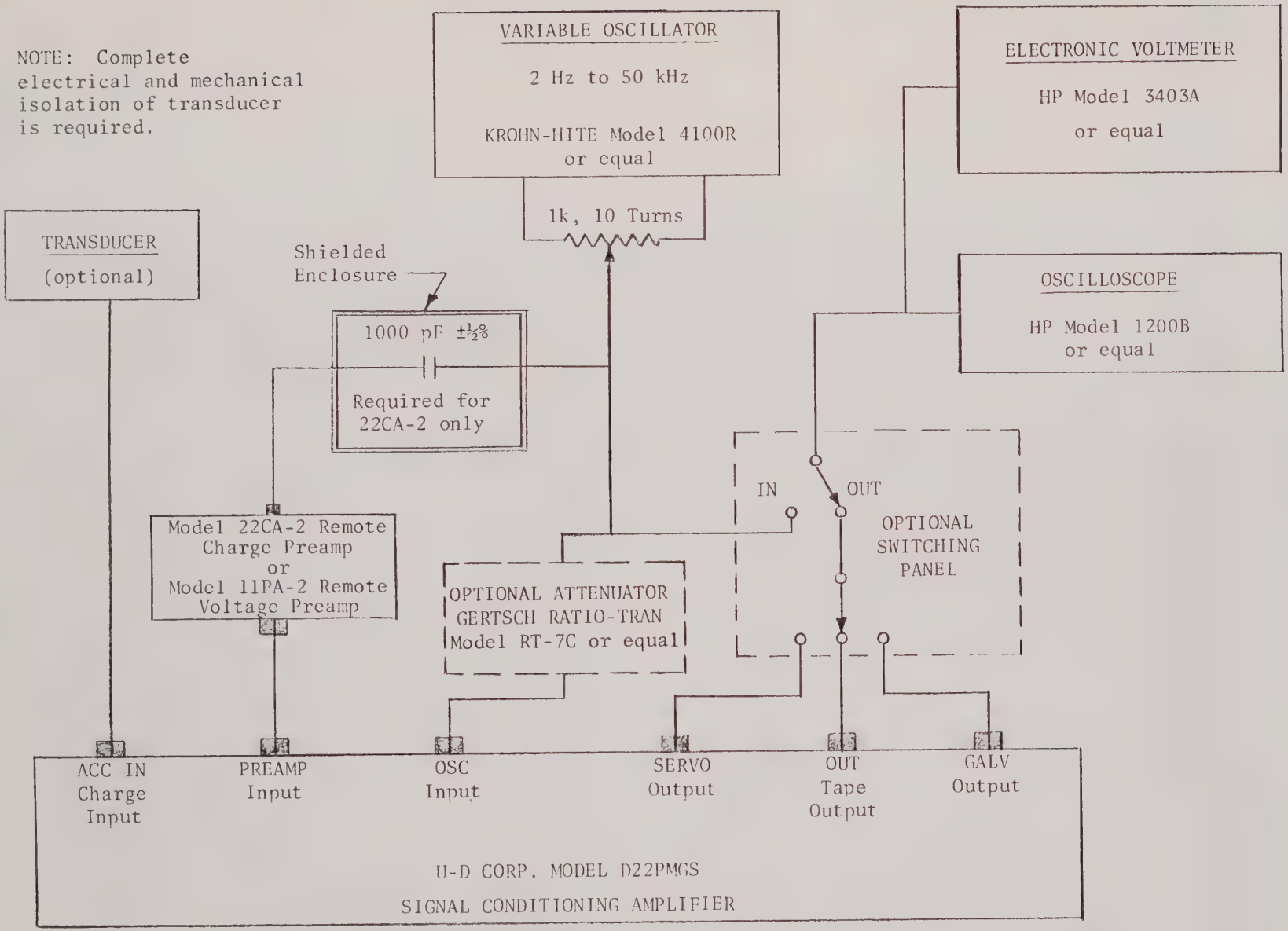
3.4.6 Place the D22 instrument on 10 g Full Scale and adjust the Y-VERNIER control to locate the pen one decade (20 dB) down from the maximum level. Place the D22 instrument on the 100 g Full Scale Range for the two decade (40 dB) down condition, and on the 1K g Full Scale Range for the three decade (60 dB) down condition. Recheck the other condition and readjust the ZERO and VERNIER controls for the best overall accuracy.

3.4.7 Connect the X input to the Log Frequency signal and set the X-ZERO and X-VERNIER controls for proper frequency calibration.

3.4.8 For ratio recording, relocate the 0 dB equal signal condition to the center of the graph paper. Check the ratio of two channels by selecting the same 100% (or other) condition on both channels. Attenuate each channel separate to check 20 dB or 40 dB changes in the (+) and (-) directio

3.4.9 The combined 60 dB dynamic range of two channels of D22 instruments can be extended to approach 120 dB total of rat plotting (transmissibility) if a U-D Model MAC-8 Averaging Control or a Model ACS-6 Signal Selector is used to provide servo control of a shaker system while ratio plots are bein made. This approach is based on the principal that the

averager or signal selector prevents any one channel from vibrating at a level appreciably above the control level, but allows each channel to decrease to any level below the control level.



CALIBRATION AND CHECKOUT INSTRUMENTATION BLOCK DIAGRAM

4. CALIBRATION - CHECKOUT

4.1 Routine Gain Calibrations

The adjustments in para. 4.1.4, 4.1.5 and 4.1.6 are the only routine calibration adjustments that are required for maintaining instrument gain accuracy. Any changes of more than 1% would suggest the need for instrument repair or a check of the procedure and connections being used.

4.1.1 Instrumentation Set-Up

Connect the instrumentation as shown in Fig. 4.1. A precision step-attenuator such as a Gertsch Ratio-Tran Model RT-7C, or equal, can be inserted between the oscillator and D22 Series instrument to facilitate range switch accuracy checks.

The use of the V-CAL mode for calibration automatically places a precision 1000 pF capacitor in series with the input charge converter.

The series calibration-capacitor that is required when calibrating the Model 22CA-2 Remote Charge Preamp must be completely shielded and connected to the input of the Model 22CA-2 by means of a low-noise shielded cable.

Always use the oscilloscope to monitor waveform purity, avoid ground loops between input and output circuits and follow recommendations in 2.4.8 for the INT. GND./ EXT. GND. switch.

4.1.2 Charge Input (ACC IN BNC)

It is not necessary to have a cable or transducer connected to the charge input for the standard calibration checks. For low level checks the connection may be covered with a shielded cap, but the center conductor cannot be shorted to the shield or ground.

4.1.3 Instrument Settings

PREAMP	- INT.
MODE	- V-CAL
CASE	- ISOL.
TAPE/GALV GAIN	- 10 TURNS (MAX)
SENS	- 10 (RANGE 1-10, TURNS = 10)
F.S. RANGE	- 10 g
Audio Oscillator	- 100 mV peak (70.7 mV rms) @ 100 Hz Connect to OSC input miniature phone jack.

NOTE: The following calibration adjustments,when required, are made from access holes located on top of the chassis as described in Section 2.2.

4.1.4 SERVO (10 mV/g) Output (Option S)
Attach CRO and ACVM to SERVO connector.
Adjust ACC potentiometer to provide 100 mV peak (70.7 mV rms

4.1.5 Meter Adjustment
Adjust METER potentiometer to provide 100% full scale meter indication.

4.1.6 F-CAL Adjustment
Change MODE switch to F-CAL position.

Adjust F-CAL potentiometer for exactly 100% full scale indication of the meter. Changing F.S. RANGE or SENS settings should not affect the meter indication.

4.2 Gain Check (Non-routine Adjustments) - These adjustments have been set carefully at the factory and should not require routine adjustment.

4.2.1 Tape and Galvo Outputs
Attach CRO and ACVM to tape OUT and/or GALV connector. After the SERVO adjustment of para. 4.1.4 has been made, use the V-CAL mode and other settings of para. 4.1.3 to veri the tape and galvo outputs are 10 V pk (7.07 V rms) ±1%.

If either the tape or galvo output requires readjustment, the internal GAIN pot located on PC Board 12311 (as described in para. 2.3.2) must be readjusted. Consult para. 5.3.3 of the Maintenance-Servicing Section for further instructions.

4.2.2 Sensitivity Dial Offset

This adjustment has been set carefully at the factory and should not require routine adjustment.

4.2.2.1 Use settings in 4.1.3

4.2.2.2 Adjust TAPE GAIN to provide 1.00 V rms ±1%

4.2.2.3 Decrease oscillator voltage to 10 mV peak (7.07 mV rms). Set SENS DIAL at 1.00.

The output voltage should be 1.00 V rms ±1%.

4.2.2.4 If the output voltage is too high (low) in 4.2.2.3, turn SENS. DIAL CCW (CW) until the stop is reached. Note the reading on the dial. Loosen the set screw on the knob and decrease (increase) the dial setting by one minor division for each 2% error in 4.2.2.3. Lock the setting, replace the dial and tighten the set screw, taking care not to move the shaft off the stop.

One adjustment is usually sufficient if the offset measurement is inaccurate by only a few percent.

4.3 Maximum Output Check

4.3.1 Instrument Settings

SENS	- 10 (RANGE 1-10, TURNS = 10)
F.S. RANGE	- 1000 (1K) g
PREAMP	- INT.
MODE	- V-CAL
TAPE/GALV GAIN	- MAX. (10 TURNS)
CASE	- ISOL
Audio Oscillator	- 10 V peak (7.07 V rms) @ 100 Hz

4.3.2 The OUT, GALV, and/or SERVO signals should not show slipping or distortion at the peaks.

4.4 Full Scale Range Switch Accuracy Check

4.4.1 With the settings in para. 4.1.3 adjust the TAPE GAIN potentiometer to 1.00 V rms at the (Tape) OUT connector for the 10 g F.S. reference condition.

4.4.2 Adjust the oscillator voltage according to the following table for associated F.S. RANGE settings. The tape OUT signal should be 1.00 V rms ±1% for all F.S. RANGE settings. The Gertsch Ratio-Tran can be used to change voltage inputs for this procedure.

Oscillator	F.S. RANGE
10.0 V pk (7.07 V rms)	1K
3.00 V pk (2.12 V rms)	300
1.00 V pk (.707 V rms)	100
300 mV pk (212 mV rms)	30
100 mV pk (70.7 mV rms)	10
30.0 mV pk (21.2 mV rms)	3
10.0 mV pk (7.07 mV rms)	1

Note: It is essential that input circuit ground loops be avoided in order to prevent errors when performing the lower level measurements. A clean, ripple-free waveform should appear on the scope for all check points. It may be necessary to place a shielded cap (not shorting) on the "ACC IN" BNC for the lowest reading.

4.5 Frequency Response Check

4.5.1 Instrument Settings - same as para. 4.1.3 except the TAPE GAIN potentiometer is adjusted to obtain a tape OUT signal of 1.00 V rms for the reference condition.

4.5.2 The percentage variations of the tape OUT signal should remain within the tolerances shown in the following table at the frequencies shown for the low pass filter condition supplied and for the "filter out" condition (sub plug-in board removed). Verify constant input voltage.

Frequency (Hz)	2	5	10	100	1K	K	K	30K
w/LP Filter Supplied	±5%	±2%	±1%	REF	±1%	±2%	-3dB ±1dB	
w/LP Filter Unplugged	"	"	"	"	"	± %	± %	±5%

Note:

1. Below 10 Hz, input and output measurements should be made on a direct-coupled oscilloscope.

2. The small, sub plug-in board with 3 capacitors that determines the low pass filter condition is described in para. 2.1.9 and Fig. 5.5.

4.6 Noise Check

The noise measurements are made at an instrument gain of 1000 mV/p

4.6.1 Instrument Settings:

SENS - 1.00 (1-10 range)

F.S. RANGE - 1 g

PREAMP - INT

MODE - OPER

TAPE GAIN - 1.00 (1 TURN)

CASE - ISOL

Connect 10 ft low noise cable and a shielded 1000 pF capacitor to the ACC IN BNC connector.

The maximum noise reading at the OUT connector should be less than 7 mV rms (.007 pC rms RTI). The noise on the scope should appear as basically random with an absence of pronounced power line frequencies.

4.6.2 With a Model 22CA-2 or Model 11PA-2 remote preamp, change the PREAMP switch to REM and connect a shielded 1000 pF capacitor across the input to the remote preamp. With the remaining settings in 4.6.1, the output noise should be

with Model 22CA-2 - 8 mV rms (.008 pC rms RTI)
with Model 11PA-2 - 40 mV rms (40 µV rms RTI)

4.7 Log DC output (Option L)

4.7.1 Instrument Settings:

PREAMP	- INT.
MODE	- V-CAL
CASE	- ISOL
TAPE/GALV GAIN	- 10 TURNS (MAX)
SENS	- 10 (1-10 range, 10 T)
F.S. RANGE	- 1000 g
AUDIO OSCILLATOR	- 10.0 V pk (7.07 V rms) @ 100 Hz Connect to OSC input miniature phone jack.

4.7.2 Connect the digital DC voltmeter to the LOG DC output connector. Allow several minutes warmup. The LOG DC output should stabilize to 0 mV ±10 mV. If out of tolerance, remove the top cover and adjust LO-L potentiometer on LOG DC card (Fig. 5.11) to obtain an output of 0 mV ±10 mV.

4.7.3 Apply .223 V rms. The LOG DC output should stabilize to -1.50 V ±10 mV. If out of tolerance, remove the top cover and adjust MID-L potentiometer to obtain an output of -1.50 V ±10 mV.

4.7.4 Apply 7.07 mV rms. The LOG DC output should stabilize to -3.00 V ±25 mV. If out of tolerance, remove the top cover and adjust HI-L potentiometer to obtain an output of -3.00 V ±25 mV.

4.7.5 Repeat 4.7.2 through 4.7.4 if necessary. The full-scale output is set by 4.7.2. The gain of the LOG DC converter is set by 4.7.3. The offset voltage of an op. amp. is balanced by 4.7.4.

4.7.6 If the meter readout should suggest a failure on the AC to DC Converter circuit that is located on the METER- SERVO PC board (Fig. 5.6), repair and recalibrate the AC-DC Converter as described in para. 2.3.3 and 2.2.3. When the meter adjustments have been correctly made, repeat para. 4.7.1 thru 4.7.5.

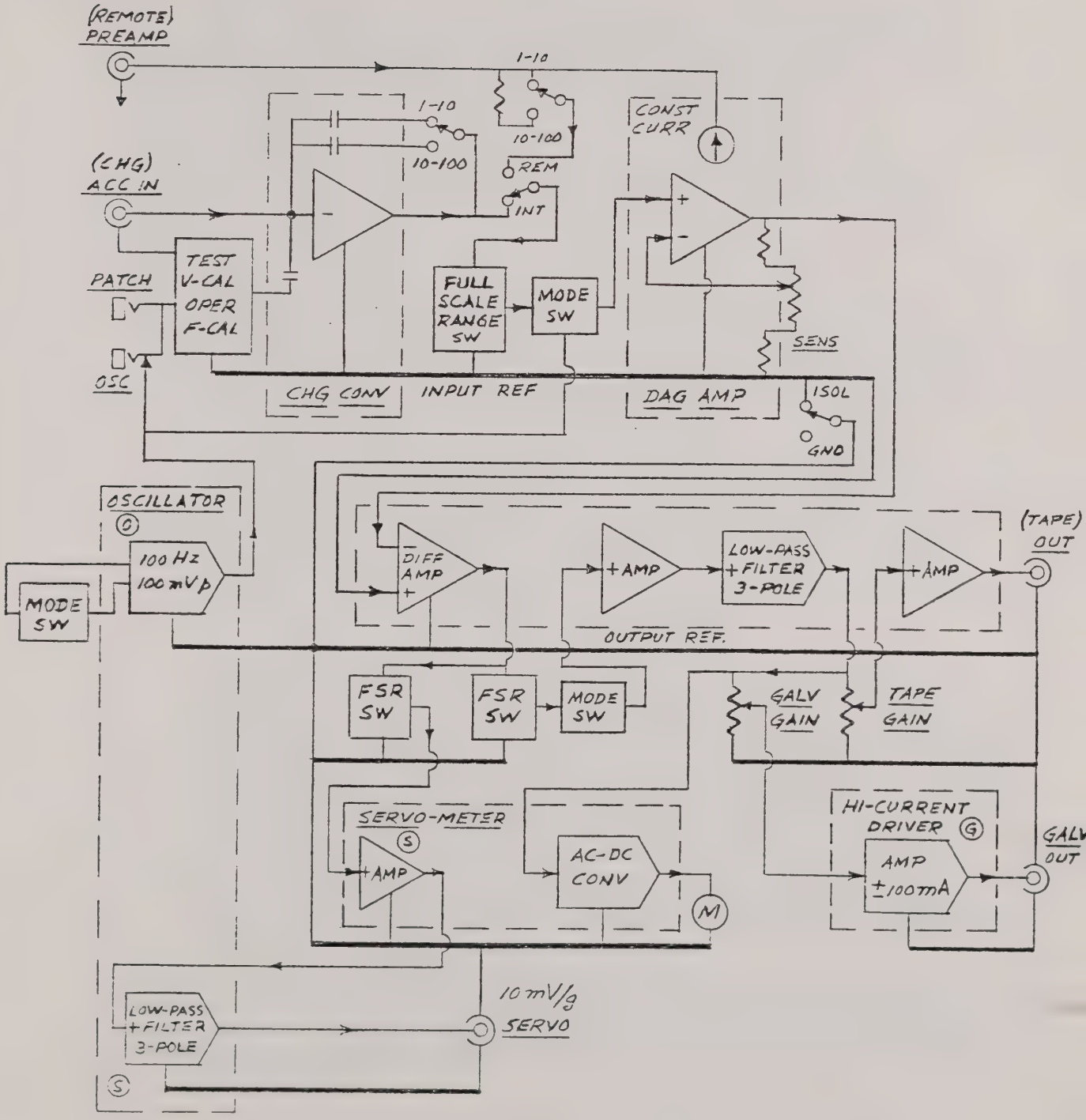


Figure 5.1
Simplified Block Diagram
MODEL D22PM(G)(S)(O)

5. MAINTENANCE-SERVICING

5.1 Block Diagram

As an aid to understanding the operation of the Model D22PM, a simplified schematic/block diagram is shown in Fig. 5.1. The complete schematic is found in Dwg. No. C12496 .

5.2 Chassis Layout

The layout of the chassis cards is shown in Fig. 5.2. The view is from the top of the chassis with the top cover removed.

5.3 Access for Servicing

5.3.1 Visual Inspection

Although normal calibration and checking procedures may be accomplished from the outside, as noted in Section 4, it may occasionally be necessary to inspect the printed circuit cards or the connector wiring for possible causes of intermittent problems or suspected failures.

The top cover may be taken off by first removing three screws on the top of the chassis at the front and rear. The cover may then be pulled up and off. To replace, slide the sides of the top cover in the groove formed by the bottom cover and the card tray and replace the screws. The removal of the top cover gives access to the printed circuit cards (except the charge converter card as described in the following para.).

5.3.2 Charge Converter Card

The charge converter card is enclosed by shields that are electrically isolated from the chassis. The bottom shield partially covers the connector contacts, and the top shield covers the charge converter card and is attached to the card by standoffs. Two screws must be removed from the underside of the card tray to permit extraction of the charge card from the connector. Both shields are electrically connected to the input reference (signal ground).

The assembly not only provides the necessary rigidity for the charge converter card but also shields critical portions of the circuit from electrical pickup.

The charge converter card and the attached shield are removed by first removing the two shield mounting screws and then pulling the assembly from the connector. The card and upper shield are separated by removing two screws from the side of the shield.

5.3.3 Internal Adjustment Pots

The DIAL-A-GAIN AMPLIFIER BAL pot and the remote preamp CURRENT ADJUST POT (Figure 5.4) and the METER BAL & ZERO pots (Figure 5.6) can be adjusted at the top of the appropriate card.

The DIFF AMP NULL pot (Figure 5.5) can be reached from above by inserting a screwdriver between two cards.

The tape 10K ohm BAL and 200 ohm GAIN pots (Figure 5.5) can be readjusted by using one of the following techniques:

5.3.3.1 Trial and Error Approach - remove the PC Board, rotate the pot, replace the board, check the output, and repeat if necessary.

5.3.3.2 Use Right-angle Adjustment Tool - a crude right angle adjustment tool can be made to reach between the PC Boards to change the GAIN or BAL pot settings This tool can be made by flattening the ends of a piece of 14 AWG bus bar and bending at 90° angles. This item can be ordered as a D22 Series Adjustment Tool.

5.3.3.3 Use Extender Card - a single sided PC Board extender card can be ordered as a D22 Series Single Sided Extender Card. When the PC Board is removed to be placed on the extender card, caution must be taken to place the PC Board on the extender card facing in the proper direction, since the index keys are no longer functional.

5.4 Voltage Measurements

Table 5.1, which follows, gives typical voltage throughout the instrument. Large deviations usually indicate a malfunction.

It is assumed that no accelerometer is connected and the CASE switch is in the ISOL position. Use a 20,000 ohm/volt multimeter for the measurements (Simpson Model 270; Triplett Model 630-NA). Reference Figure 5.2 for PC card description and location.

CARD	TERMINAL(S)	VOLTAGE
OUTPUT POWER SUPPLY	1-2	20 ± 4 V AC rms
OUTPUT POWER SUPPLY	1-3	20 ± 4 V AC rms
OUTPUT POWER SUPPLY	10-6 (REF)	14.5 ± .5 V DC
OUTPUT POWER SUPPLY	9-6 (REF)	14.5 ± .5 V DC
INPUT POWER SUPPLY	1-2	25 ± 4 V AC rms
INPUT POWER SUPPLY	1-3	25 ± 4 V AC rms
INPUT POWER SUPPLY	10 *	21 ± .5 V DC
INPUT POWER SUPPLY	9	21 ± .5 V DC
CHARGE	H	0 ± .010 V DC
DIAL-A-GAIN AMPLIFIER	8	0 ± 0.5 V DC
DIFF-LP FILTER - TAPE	3	0 ± 0.5 V DC
HIGH-CURRENT DRIVER	1	0 ± .001 V DC
HIGH-CURRENT DRIVER	10-8	12 ± 2 V AC rms
HIGH-CURRENT DRIVER	9-8	12 ± 2 V AC rms

*All DC Voltage Measured Relative to Pin 6

TABLE 5.1

5.5 Servicing Malfunctions

The detailed calibration and checkout procedures in Section 4 and the voltage measurements in Section 5.4 should be of great help in pinpointing possible trouble. In addition, standard signal tracing techniques proceeding generally from input to output and making use of the oscilloscope are of great help.

The printed circuit cards are also removable, which helps locate short-circuit malfunctions.

If replacement of any component is necessary on a printed circuit board, the excess solder at the points of insertion should first be removed by either a soldering iron and a desoldering wick (Dri-wick-American Electrical Heater Co.) or a desoldering bulb (Ungar #7805 Solder-Off Bulb). Combinations of soldering irons and bulbs are also available (Ungar Model 7800 Hot-Vac Tool).

Removal of integrated circuits is best accomplished by using a special soldering iron tip designed to fit around the IC pins and an extractor. The excess solder around the insertion points is removed by the method of choice, and the IC pins are then straightened. The card is then clamped in a bench vise, the pins are heated with the special soldering iron tip (Princess 6902 Handle 6918 Heat Capsule, and 6948 tip) and the integrated circuit is pulled out with the extractor.

When the soldering wick is used, the integrated circuit may often be pried out carefully without the use of the special soldering tool.

Care should always be taken in removing components to avoid delamination of the conductor from the printed-circuit card.

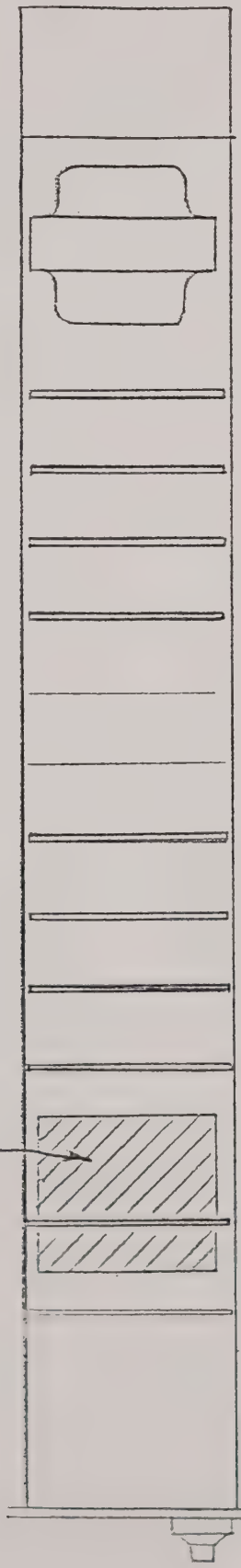
5.6 Component Location

Figures 5. through 5. show the component layout for each of the circuit boards.

5.7 Following is ordering information for integrated circuits, semiconductors, and other critical components used in the Model D22PM. Other resistors and capacitors are available from standard distributor stock and are adequately identified on the PC Card layouts and circuit schematic diagram.

PART NO.	DESCRIPTION	MANUFACTURER
NE5534	I.C. Op. Amp	Signetics
LM301AN	I.C. Op. Amp	National, Raytheon
UGA7723393	I.C. Voltage Regulator	Fairchild (μA723)
AD842	Dual FET	Micro Power
T1S92 (G opt)	Si. NPN	Texas Inst.
T1S93 (G opt)	Si. PNP	Texas Inst.
2N4922	Power NPN	Motorola
2N4919	Power PNP	Motorola
1N5394	Si Rectifier	Westinghouse
2N5363	N FET	Motorola
1N5312 (G opt)	Const Current Diode	Motorola
1000pF ½%	Mica Cap	General Inst./Miconics
2000pF ½%	Mica Cap	General Inst./Miconics
9,000pF ½%	Mica Cap	General Inst./Miconics
33-101	BNC to Microdot Adapter	Amphenol
T-82-E	Power Transformer	U-D Corp.

FIG 5.2 CHASSIS LAYOUT

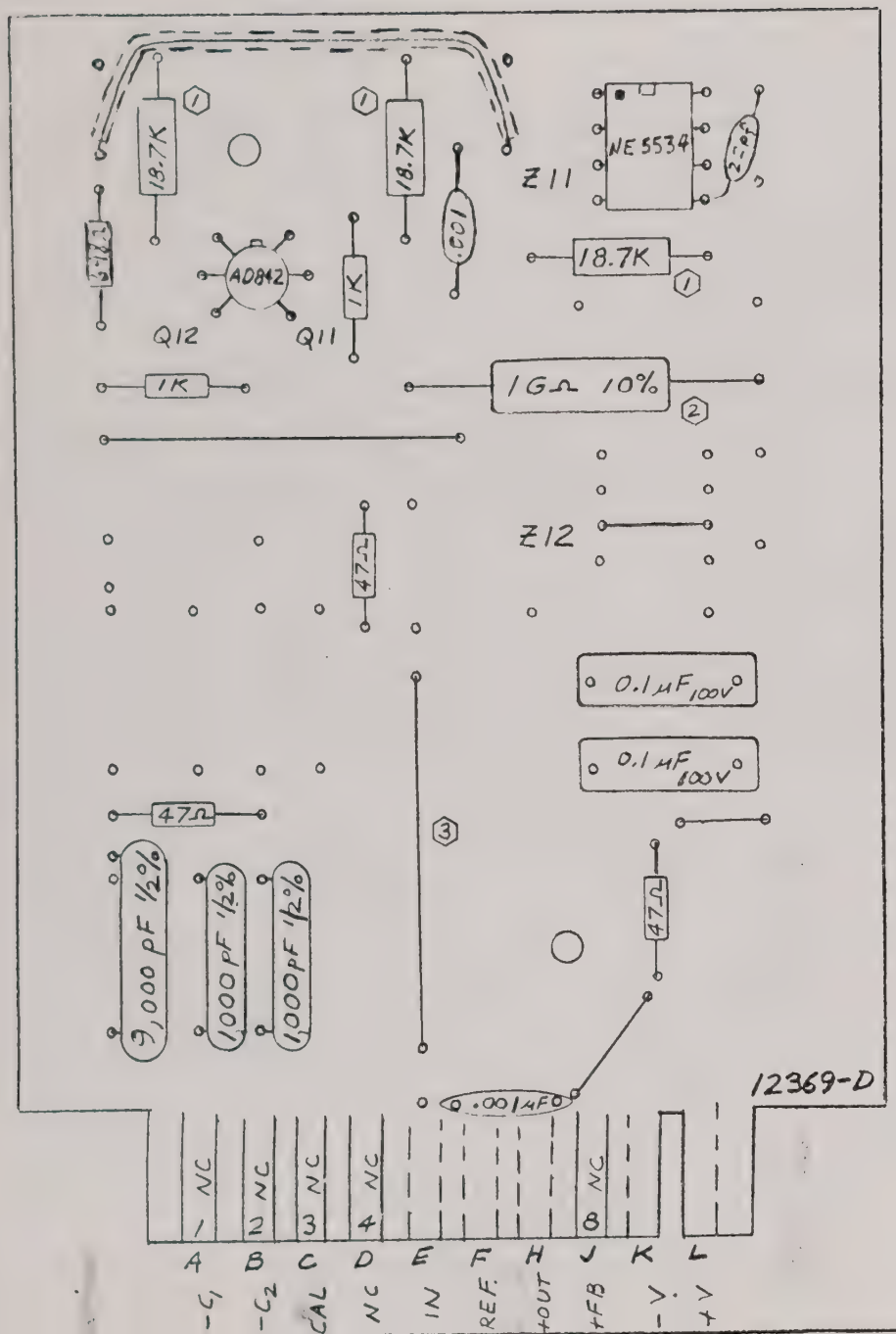

Rear
POWER TRANSFORMER
INPUT POWER SUPPLY (PC BD 12309C) Fig. 5.10
OUTPUT POWER SUPPLY (PC BD 12309C) Fig. 5.9
HI-CURRENT DRIVER (OPTION G) (PC BD 12317) Fig. 5.8
SERVO FILTER-OSC-T.F.(OPTION S,O,T) (PC BD 12493) Fig. 5.7
LOG DC (PC BD 12401) Fig. 5.11
METER-SERVO (PC BD 12373) Fig. 5.6
DIFF-LP FILTER-TAPE (PC BD 12311) Fig. 5.5
DIAL-A-GAIN AMP.(PC BD 12307) Fig. 5.4
CHARGE CONVERTER (PC BD 12369) Fig. 5.3
Front

Components on all cards face rear

Metal deck insulated from chassis - Kept at input reference (charge conv. cover removed)

MODEL D22PM(GSLTO)

6/83	B	NE 531 → NE5534	MF



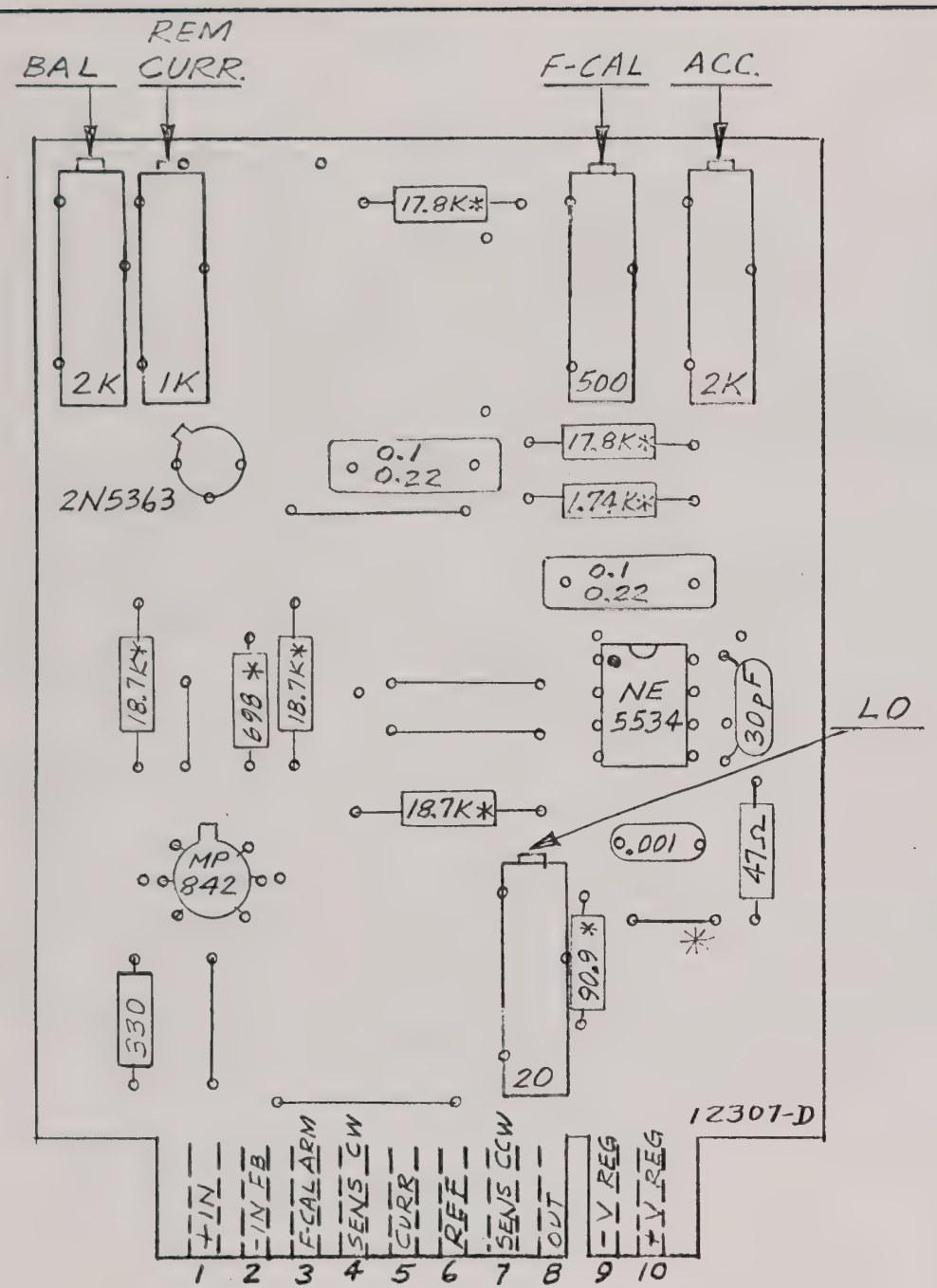
① 1% METAL FILM

② 5GΩ FOR -2

③ 2.2μF/100V FOR K OPTION

D22PM

	UNHOLTZ-DICKIE CORP
	2X
	COMPONENT LAYOUT CHARGE CONVERTER
	FIGURE 5.3



REVISIONS			
SYM	DATE	DESCRIPTION	BY

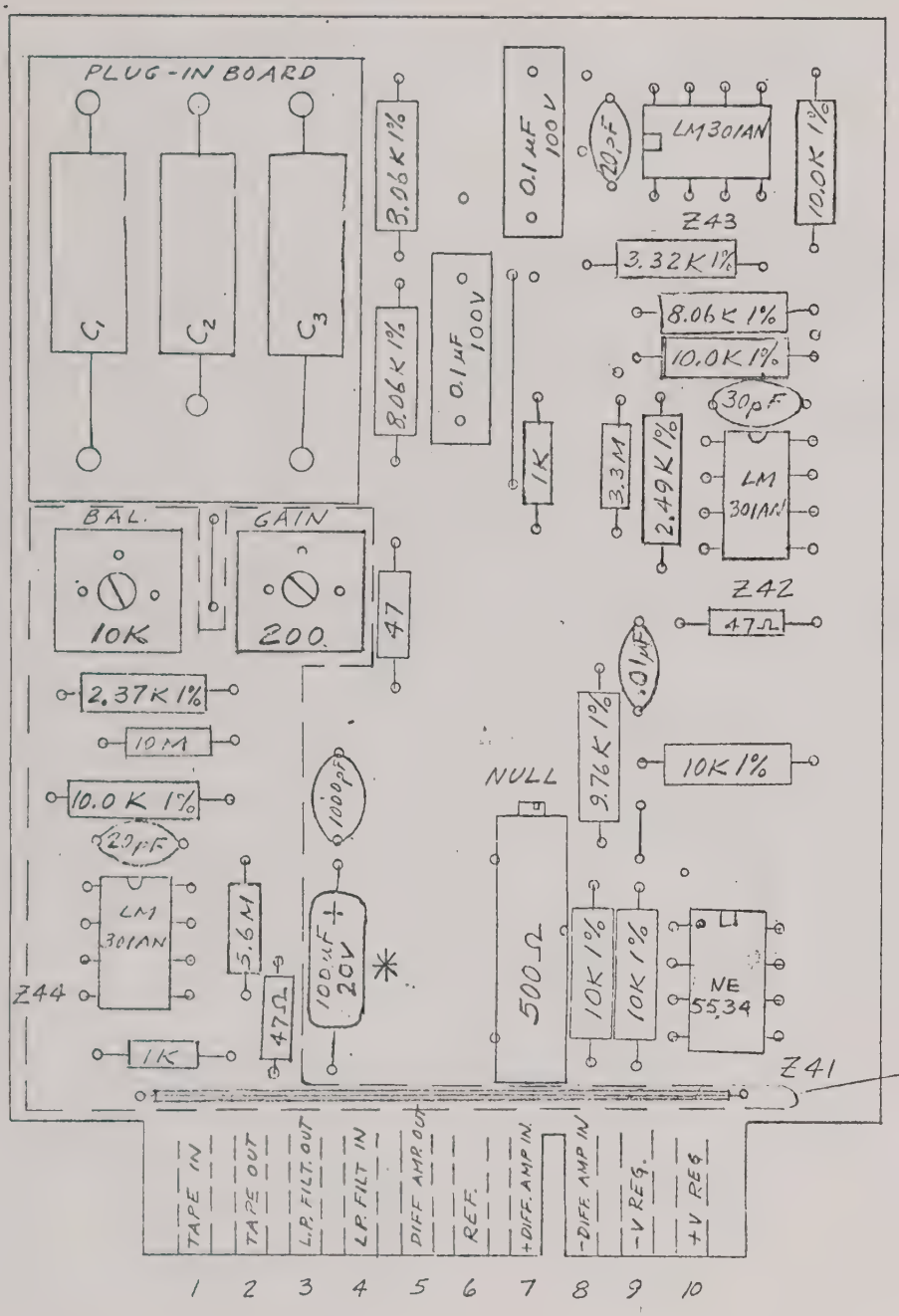
* JUMPER REPLACED BY 100/20V CAP. FOR "T" OPTION

UNHOLTZ-DICKIE CORP.

D22PM, D22PMH, D22PMR

COMPONENT LAYOUT
DIAL-A-GAIN CARD

6-1-85



	STD. 10kHz (±2% RESP)	5KHz
C_1	2000 pF ±2%	4000 pF
C_2	500 pF ±5%	1000 pF
C_3	1000 pF ±½%	2000 pF

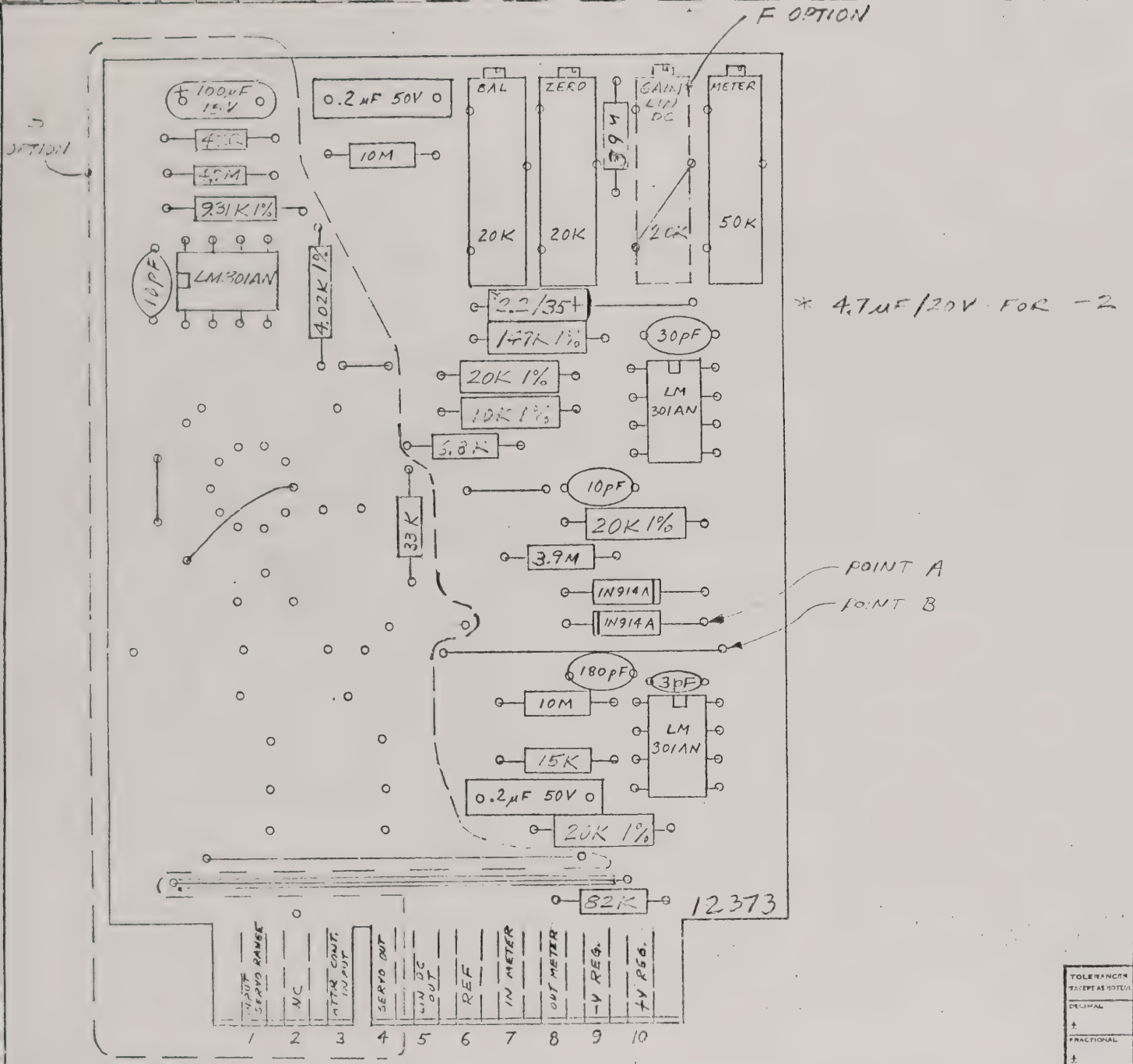
NOTE : C_2 adjusted at factory

* JUMPER FOR PMH.
2 X 160/20 FOR PM-2

DELETE WITH "C" OPTION

D22 PMH; PMH-2
D22PM

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP
DECIMAL ±	SCALE 2X DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE DIFF. AMP. - L.P. FILTER-TAPE COMPONENT LAYOUT
ANGULAR ±	DATE 9-19-72 DRAWING NUMBER FIGURE 5.5



* 4.7μF/20V FOR -2

REVISION RECORD					
NO.	LTR	LAND'S CHGD	BY		

D22PM
D22PMH
S&F OPTIONS

UNHOLTZ-DICKIE CORP.

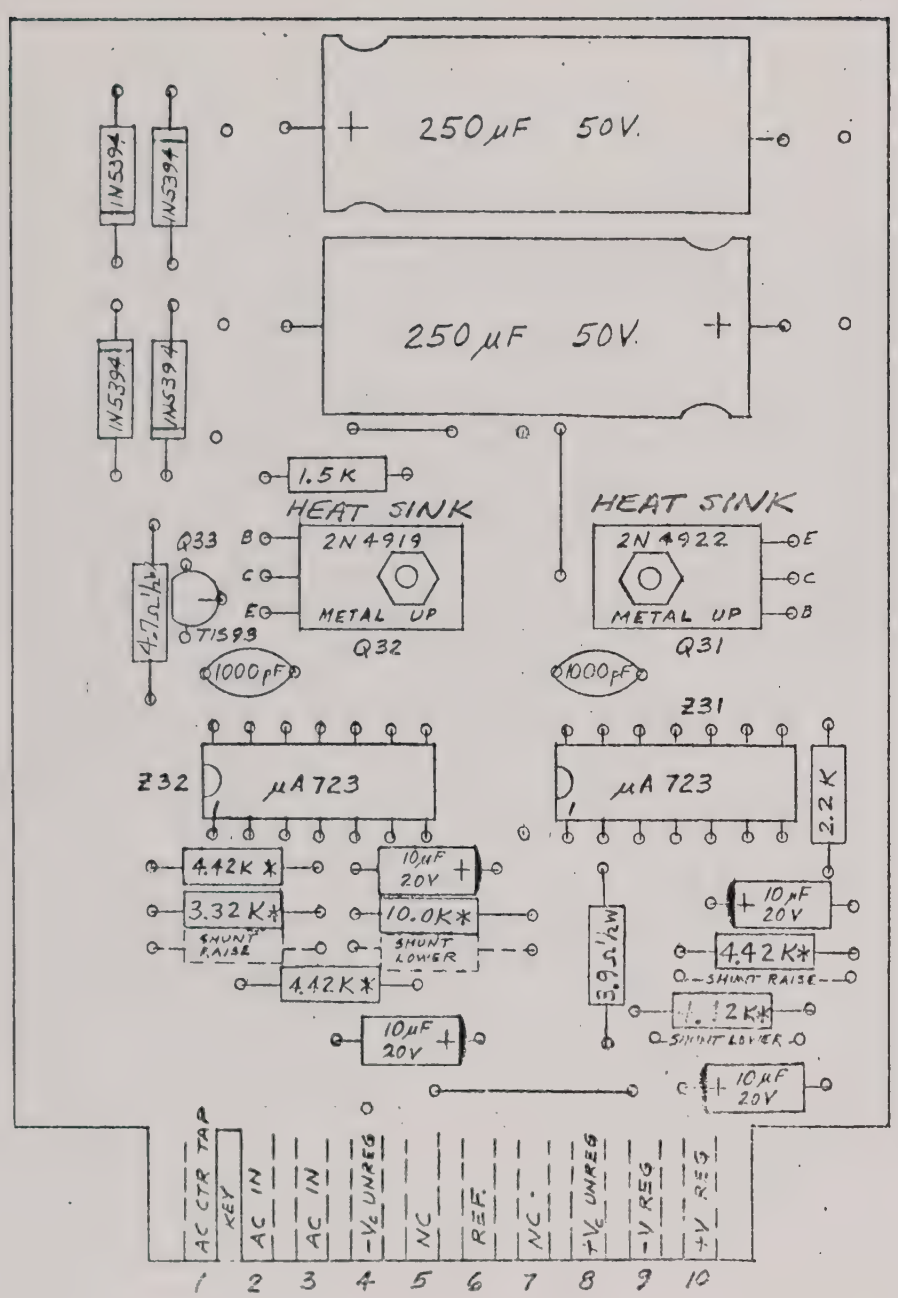
TOLERANCES EXCEPT AS NOTED
DECIMAL ±
FRACTIONAL ±
ANGULAR ±

SCALE
DRAWN
APPROVED BY

TITLE COMPONENT LAYOUT METER-SERVO CARD

DATE 10-30-73

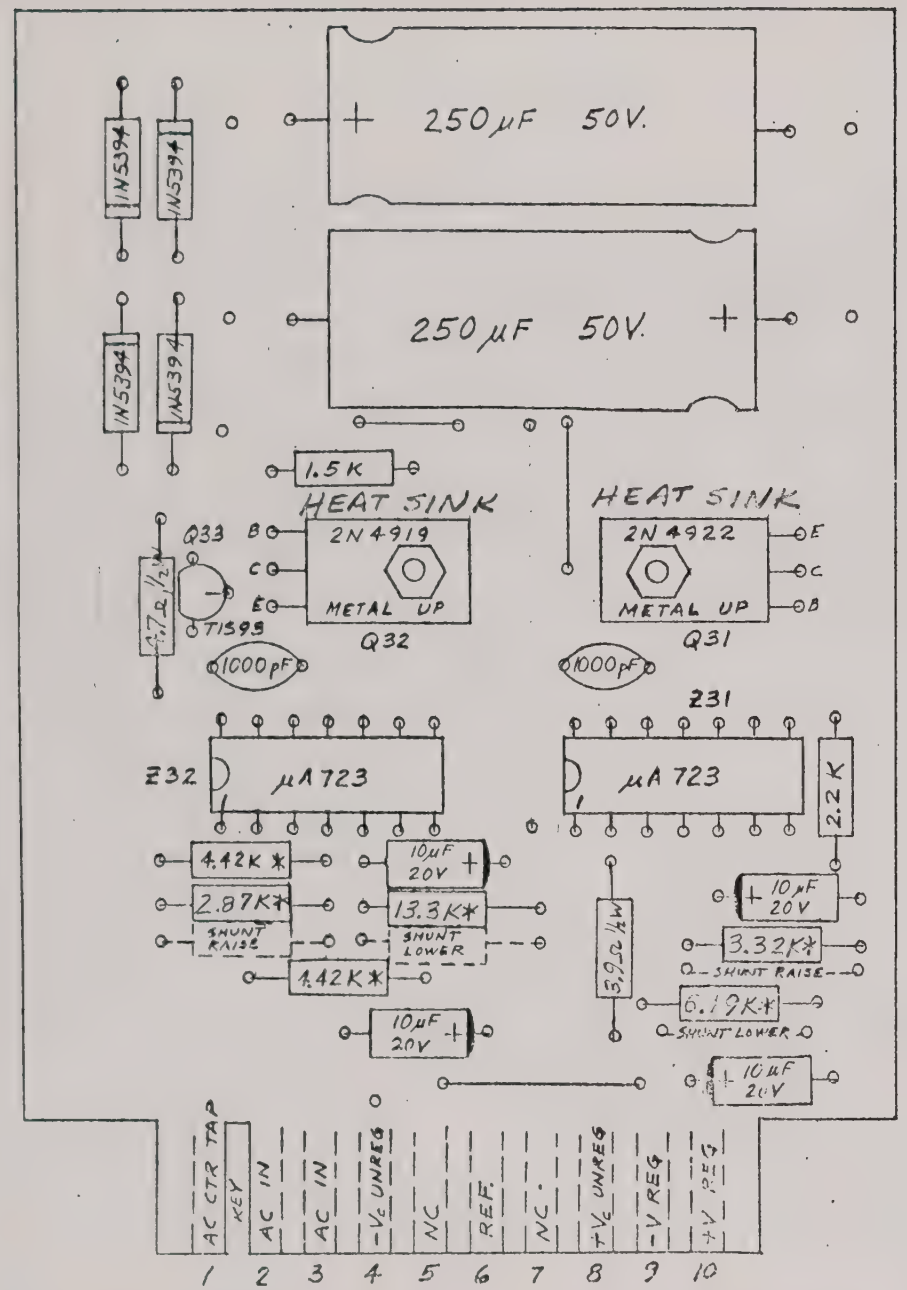
DRAWING NUMBER FIGURE 5.6



OUTPUT POWER SUPPLY

D22 SERIES

TOLERANCES	UNHOLTZ-DICKIE CORP
±15V	
TITLE: COMPONENT LAYOUT DUAL REG. POWER SUPPLY	
DATE: 10-1-74	

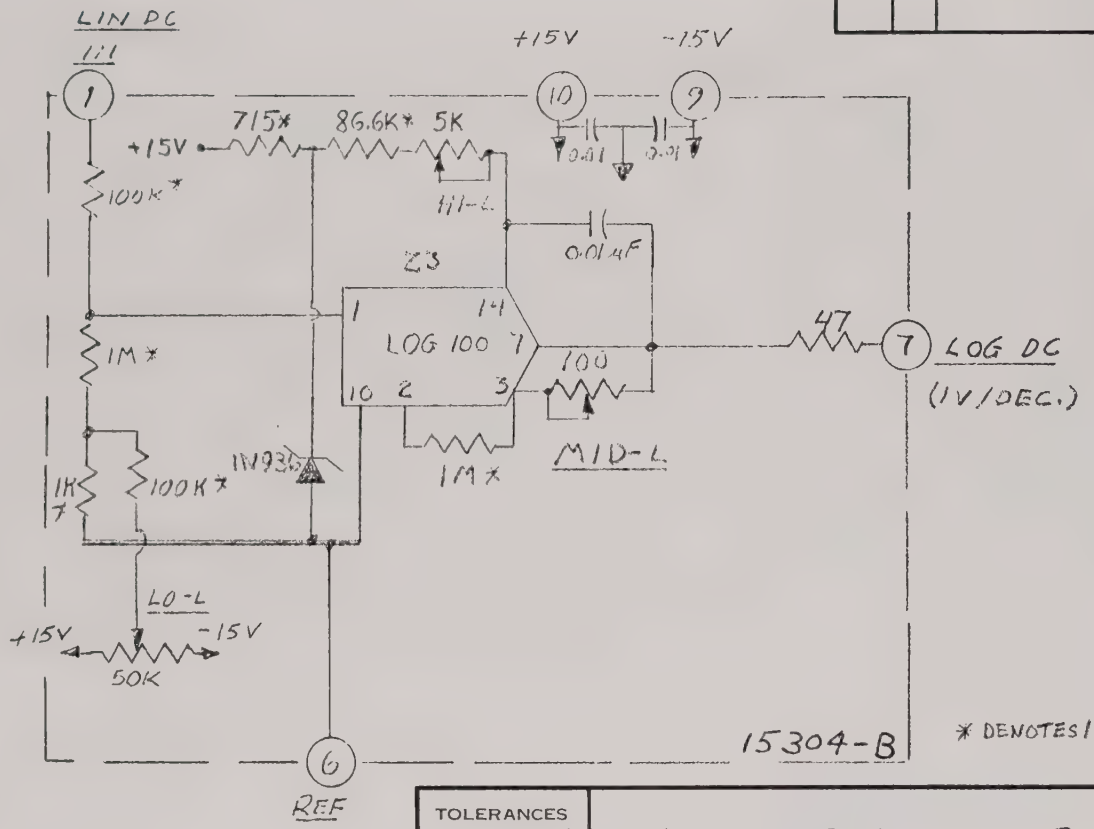


INPUT POWER SUPPLY

D22PM 122P
D22PMH
D22PMR

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP
DECIMAL ±	± 21V
SCALE	
DRAWN BY	TU
APPROVED BY	
FRACTIONAL ±	TITLE COMPONENT LAYOUT DUAL REG. POWER SUPPLY
ANGULAR ±	DATE 10-4-74
DRAWING NUMBER	

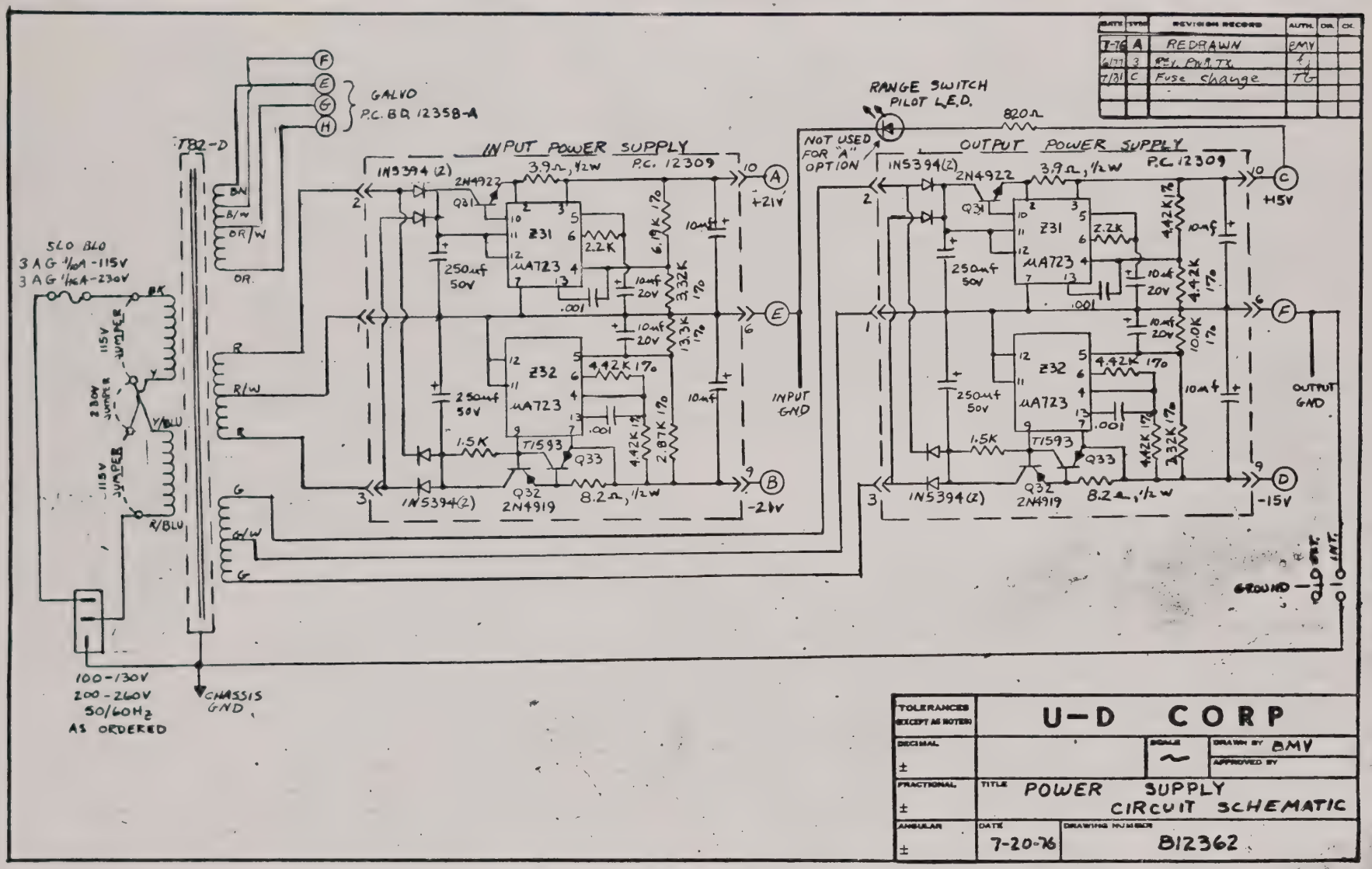
DATE	SYM	REVISION RECORD	AUTH	DR.	CK.



TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP		
DECIMAL ±		SCALE	DRAWN BY / APPROVED BY
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC LOG DC CONVERTER		
ANGULAR ±	DATE	DRAWING NUMBER A19766	

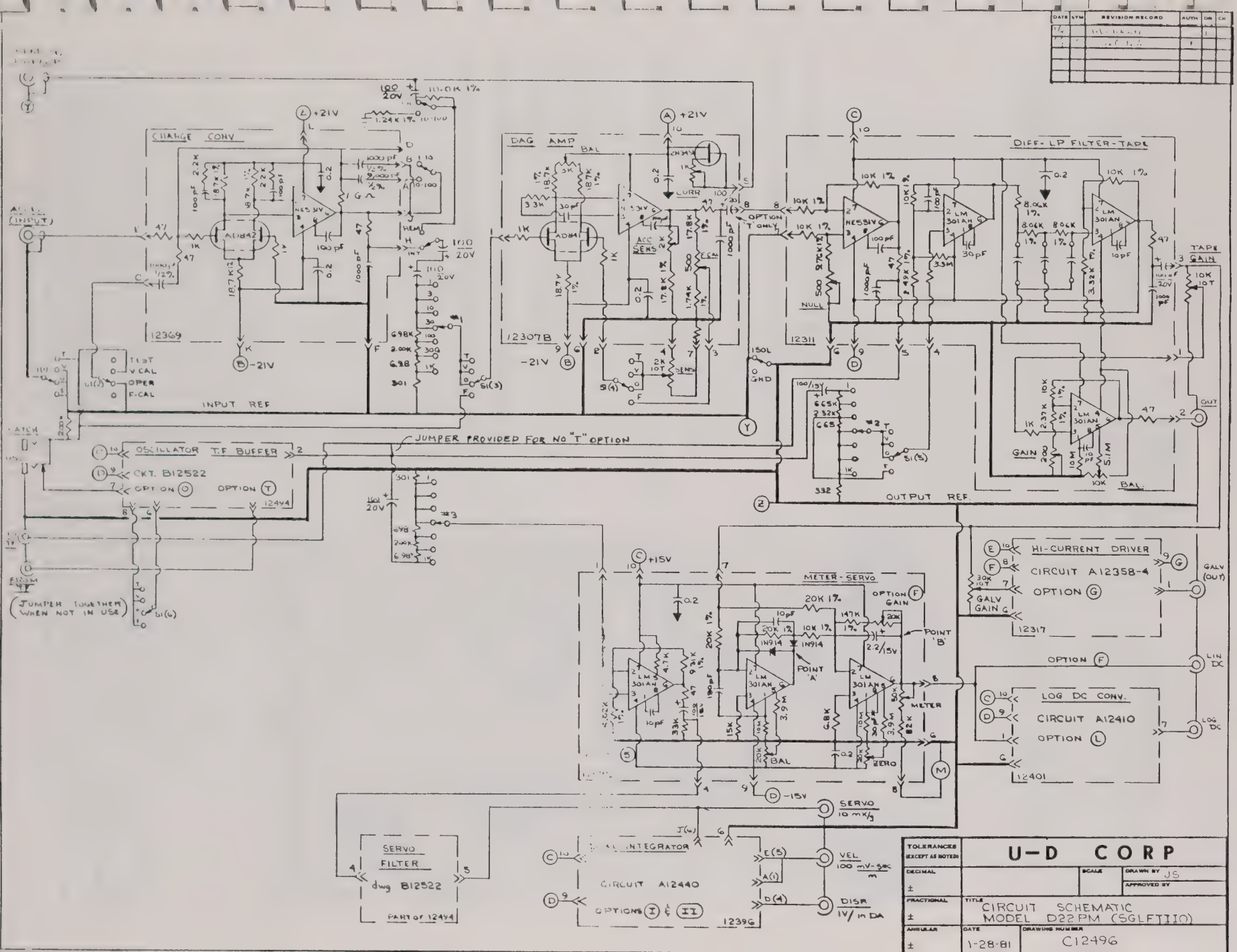
K+E ALBANENE ® 10 5465

MADE IN U.S.A.



DATE	TYP	REVISION RECORD	AUTH.	DR.	CK.
7-76	A	REDRAWN	BMV		
6/77	3	REV. PWR. TX	4		
7/81	C	Fuse change	TG		

TOLERANCES (EXCEPT AS NOTED)	U-D CORP		
DECIMAL ±		SCALE ~	DRAWN BY BMV
			APPROVED BY
FRACTIONAL ±	TITLE POWER SUPPLY CIRCUIT SCHEMATIC		
ANGULAR ±	DATE 7-20-76	DRAWING NUMBER B12362	



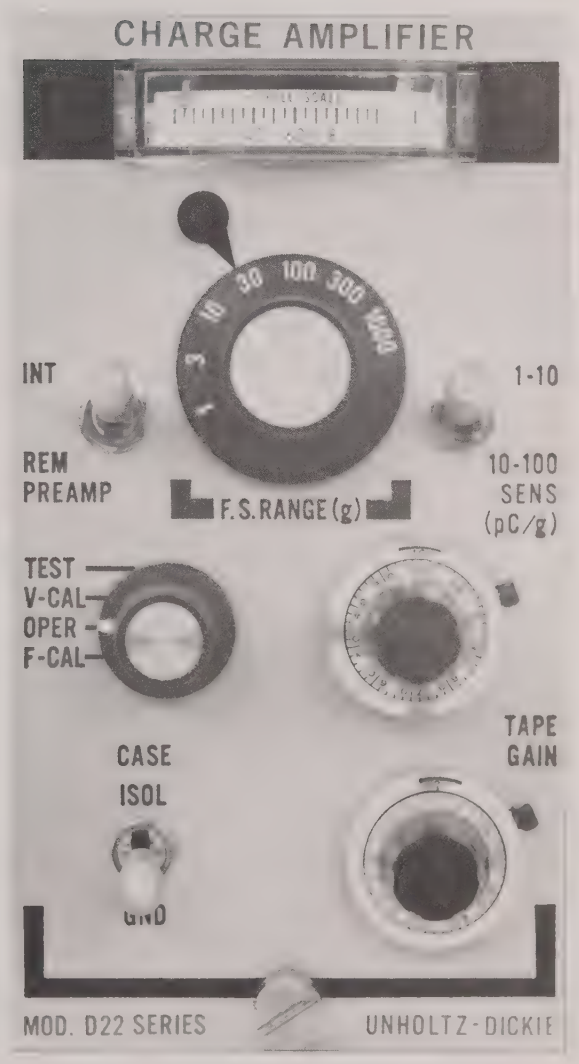
TOLERANCES (EXCEPT AS NOTED)	U-D CORP	
DECIMAL ±		SCALE / DRAWN BY JS / APPROVED BY
FRACTIONAL ±	TITLE: CIRCUIT SCHEMATIC MODEL D22PM (SGLFIII0)	
ANGULAR ±	DATE: 1-28-81	DRAWING NUMBER: C12496

UNHOLTZ-DICKIE CORPORATION

VIBRATION TEST EQUIPMENT

Model D22PM

CHARGE AMPLIFIER



- EXTREMELY LOW-NOISE OPERATION
- DIAL-A-GAIN SENSITIVITY NORMALIZATION
- CALIBRATED FULL-SCALE OUTPUT
- OPERATION WITH REMOTE PREAMPLIFIERS
- DIFFERENTIAL REJECTION OF GROUND SIGNALS
- PLUG-IN 3-POLE FILTER
- LOW POWER CONSUMPTION
- THREE CALIBRATION MODES
- INSENSITIVE TO EXTERNAL VIBRATION
- INDIVIDUAL SHIELDED POWER SUPPLIES
- WIDE VARIETY OF OPTIONS

The D22PM features plug-in card construction, extensive use of integrated circuits and rugged construction. Independent power supplies and shielded transformers are used so that individual operation is possible, grounding problems are minimized in large installations, and excellent power line isolation is provided.
In addition, separable references are provided for the input and output circuits so that an internal differential circuit can remove common-mode ground voltages caused by having the transducer case grounded at the point of measurement.
The Dial-A-Gain sensitivity normalization, originated by Unholtz-Dickie, allows the various outputs to be normalized for piezoelectric transducer sensitivities ranging from 0.5 to 100 pC/unit.
Being a charge amplifier, the gain of the D22PM is, or course, insensitive to input cable length.

NOISE

Extremely low output noise has been attained by careful selection of the input FET for the charge converter. Careful shielding, highly regulated power supplies and balanced circuitry can be selected to optimize the signal-to-noise ratio by proper knowledge of the expected signal spectrum.

Using the D22PM and a modern shear mode accelerometer having a sensitivity of approximately 50 pC/g with a relatively short low-noise cable, it is possible to achieve a typical noise level of 50×10^{-6} g rms over a 10 kHz frequency range. This means that acceleration levels less than .001 g may be accurately measured.

OUTPUTS

The standard tape output is calibrated to give exactly 10 V peak for full scale inputs for full clockwise rotation (10 turns) of the TAPE GAIN potentiometer. The locking dial accurately determines full scale output for other settings. The 1.24 inch scale edge-reading meter is calibrated in percent of full scale. Options include servo control (S) at 10 mV/g, a high-current driver for long lines or galvanometers (C or G), linear DC output (F), and logarithmic DC output (L).

RANGES

The maximum instrument gain, for a full scale range setting of 1 g and an input sensitivity of 1 pC/g, is 10 V/pC. Standard manual ranging provides seven full scale ranges from 1 to 1000 g in 1, 3, 10 steps, for input sensitivities from 1 to 100 pC/g.

The high gain option (-3) gives a maximum gain of 100 V/pC and nine ranges from 0.1 to 1000 g in 1, 3, 10 steps.

The automatic ranging option (A) provides four full scale ranges: 1, 10, 100 and 1000 g. The front panel switch has six positions, four for manually selecting each of the above ratings, one for the external range control mode (E) and one for the autoranger mode (A). In the autoranger mode, the instrument switches to the next higher range at 105% of full scale and to the next lower range at 8.5% of full scale. Two-bit external control of the full scale range is possible in the E-position. Two-bit readout of the range allows units to be daisy-chained for simultaneous control of large instrument arrays. The full scale range is indicated by a red LED. See Figure 1.

FILTERS

A three-pole low-pass Butterworth filter is contained on a sub-plug-in board within the instrument. The instrument may be operated with the filter plug-in removed if desired. Other filter frequencies are easily and economically supplied.

CALIBRATION

The D22PM provides three calibration/checking Modes: F-CAL, V-CAL, and TEST. The F-CAL mode provides full scale output for 100 mV peak input regardless of range and sensitivity settings. The V-CAL mode provides an output dependent on all front-panel settings. The TEST mode inserts the calibration signal in series with the accelerometer cable shield. An open or shorted line is easily detected.

REMOTE PREAMPLIFIER

Remote voltage preamplifiers or charge preamplifiers such as the U-D Model RCA-2TR, are accommodated by changing a front panel switch from INT. to REM. This allows the internal charge converter to be bypassed and means that standard low-cost coaxial cable may be used between the measurement site and the instrument. Triboelectric noise for long-line measurement is also avoided.

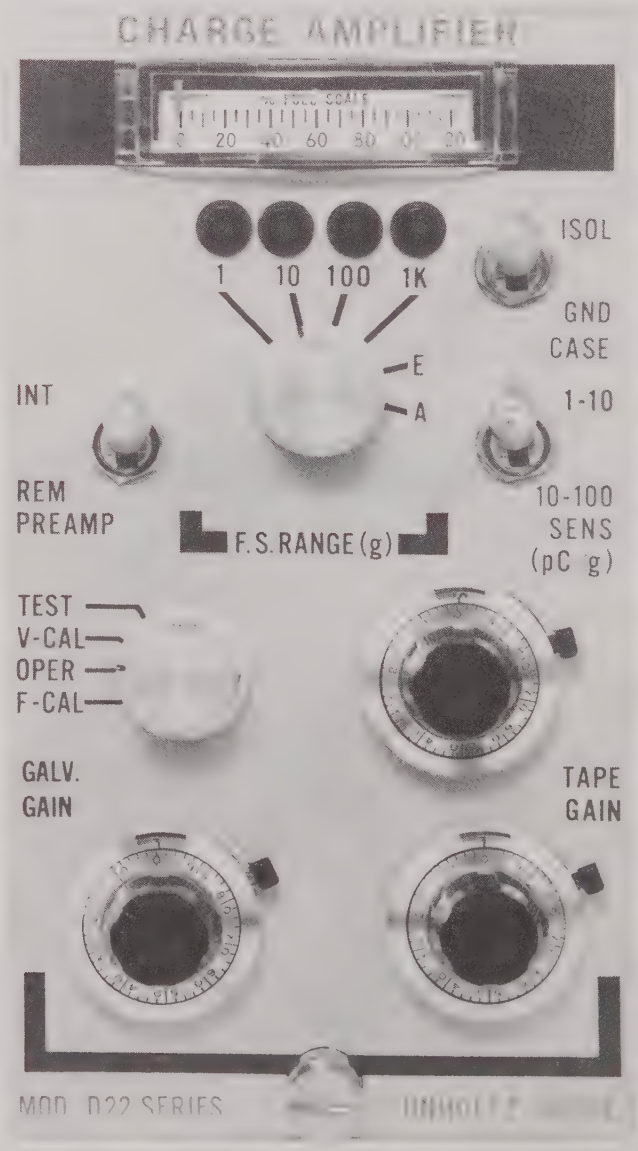
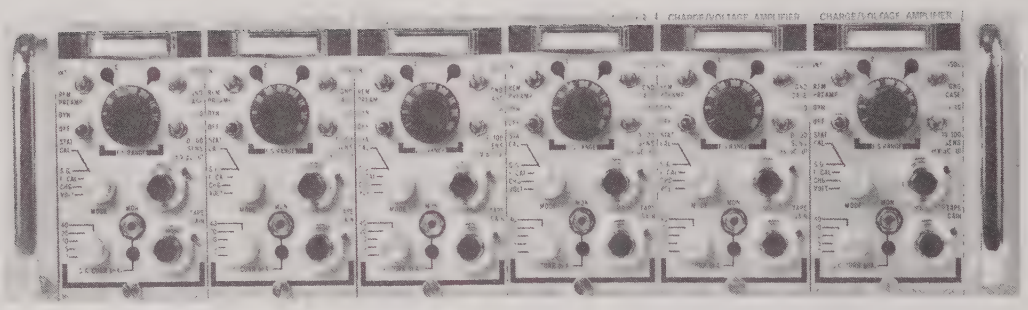


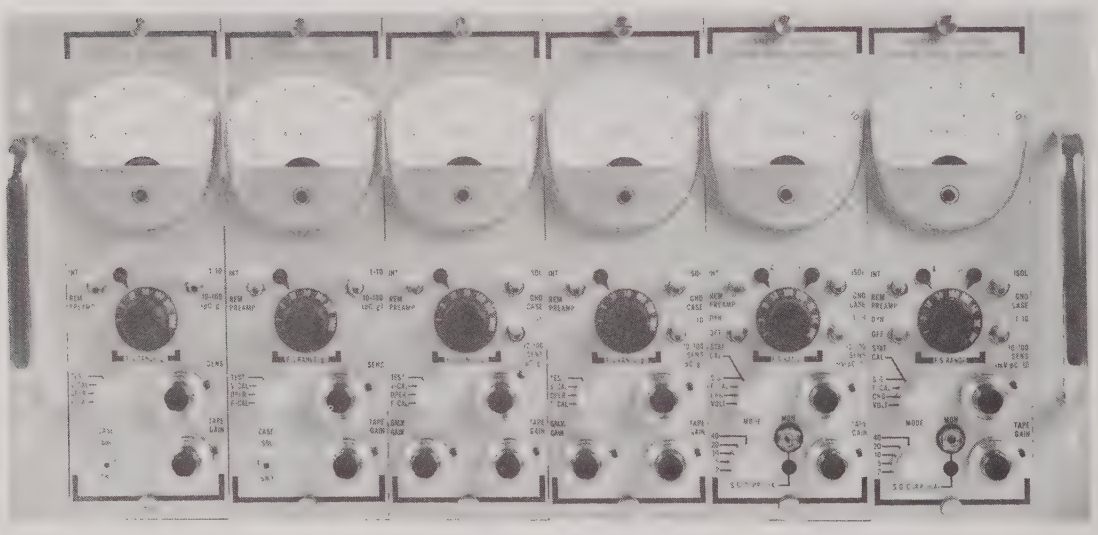
Figure 1. Model D22PMGA Charge Amplifier with Autoranging and Galvo Driver Options

SPECIFICATIONS MODEL D22PM

1. **GENERAL**
   - 1.1 Separate, isolated power supplies are provided in each channel
   - 1.2 All power and signal connections are made at separate rear mounted connectors.
   - 1.3 Each channel is totally enclosed so that it can be used with equal convenience as a bench mounted or as a rack mounted instrument.
2. **INPUT CHARACTERISTICS**
   - 2.1 Charge input — direct connection to any piezoelectric transducer with 10 Megohms, or greater, shunt resistance.
   - 2.2 Remote Preamp Input — two-wire connection to remote charge type or voltage type preamp that can be added to the sytem at anytime. The Preamp connector supplies the required bias voltage/current to the remote preamp.
   - 2.3 Gain Change with Source Capacitance in Charge Mode (INT.) — A source capacitance of 50,000 pF shall cause less than 0.1% gain change for transducers having a sensitivity between 1 and 100 pC/unit.
   - 2.4 Gain Change with Remote Preamp Mode (REM. PRE-AMP) — All instrument gain controls and range switches shall apply when operation is converted to the remote preamp mode. The basic instrument accuracy shall change by less than ±1%. Up to 2,000 feet of RG58/U coaxial cable shall cause a gain change of less than 1% when connected between the instrument and the remote preamp.
   - 2.5 Maximum Input in Charge Mode (INT.)
     ±15,000 pC (1 to 10 pC/g.)
     ±150,000 pC (10 to 100 pC/g.)
3. **OUTPUT**
   - 3.1 Tape Driver — Calibrated ±10 V peak at full scale condition into 1 K load. Ten turn locking potentiometer allows precision adjustment between 0 to 10V. Output impedance less than 50 ohms direct-coupled.
   - 3.2 Standard Meter — 1.24 inch scale meter calibrated in percent of full scale. Accuracy ±2% of full scale; average detector provided. Dual scale is available upon request.
   - 3.3 Large Meter (Option "-8") — 2.5 inch scale length with 2 scales calibrated 0 – 10 and 0 – 3. Increases front panel height to 8¾ inches.
   - 3.4 Servo Control (Option "S") — Output normalized to 10 mV pk/g pk, not dependent upon range switch position. No signal clipping occurs at the servo output at levels less than 100 g on any full scale range, and operates to 1000 g without clipping when placed on that range.
   - 3.5 Galvanometer Driver (Option "G") — A high current amplifier provides a separate independent output with a current capacity of ±100 mA. Ten turn locking potentiometer allows precision adjustments between 0 and 10 V. Output impedance less than 1 ohm direct-coupled.
   - 3.6 Log DC Output (Option L) — A DC output proportional to the logarithm of the input amplitude. The calibration constant is +1.0 V/decade and an output of 0 V DC is provided at full scale.
   - 3.7 Velocity Integrator (Option I) — Output normalized to 100 mV-sec/in, not dependent on range switch position.
4. **FREQUENCY RESPONSE**
   - 4.1 Low Pass Filter "Plug-In" Removed
     ±1% 10 Hz to 10 kHz
     ±5% 2 Hz to 30 kHz
   - 4.2 Low Pass Filter "Plug-In" Installed — Plug-in component card supplied with unit is 3 pole maximally-flat Butterworth design. Filter frequency f_O can be supplied in 1, 2, 5, 10 sequence from 50 Hz to 10 kHz. Response at f_O is rated ±2% and at 2 f_O is -3 dB ±1 dB, with 18 dB/oct. attenuation rate.
5. **RANGE SWITCHING**
   - 5.1 Standard — 1 to 1 K g full scale in 1-3-10 sequence for 1-100 pC/unit.
   - 5.2 Option 3 — .1 to 1 K g full scale for 1-100 pC/unit in 1-3-10 sequence.
   - 5.3 Option A — Full-scale ranges of 1, 10, 100 or 1000 g controlled by the front panel switch or automatically selected by signal amplitude. Two-bit digital readout of full scale range. Full-scale range also externally controllable by two-bit digital input compatible with TTL or CMOS logic (specify which).
6. **MAXIMUM NOISE** (RTI-referred to input; RTO-referred to output) All statements refer to 10 kHz low-pass filter, and 10 Megohm input resistance or greater.
   - 6.1 Standard Range Option — .005 pC rms plus .0015 pC rms/1000 pF source capacitance RTI for 1-10 pC/unit and .05 pC rms plus .0015 pC rms/1000 pF source capacitance for 10-100 pC/unit RTI plus 1 mV rms RTO.
   - 6.2 Range Option 3 – .005 pC rms plus .0015 pC rms/1000 pF source capacitance RTI for 1-10 pC/unit and .05 pC rms plus .0015 pC rms/1000 pF RTI for 10-100 pC/unit. plus 5 mV rms RTO.
7. **CALIBRATION MODES**
   - 7.1 F-CAL — provides full-scale output for 100 mV peak input independent of full scale range or sensitivity setting.
   - 7.2 V-CAL — connects calibration signal through precision 1000 pF ±½% capacitor directly to charge amplifier input providing 1 pC/mV conversion.
   - 7.3 TEST — connects calibration signal in series with shield of input cable.
   - 7.4 OPER — calibration signal disconnected for normal operation.
   - 7.5 Internal Oscillator (Option O) — provides calibration signal of 100 mV peak ±1% at 100 Hz. One oscillator can supply a total of six channels with patch cables supplied.
8. **GROUND SIGNAL REJECTION —** This input ground/output ground isolation feature allows the transducer case to be grounded at the test site without introduction of output due to ground loops.
   - 8.1 The output voltages normally created by ground loops due to grounded transducer cases are rejected by at least 60 dB at maximum instrument gain from 5 Hz to 1 kHz.
   - 8.2 The front panel range switch lamp verifies the correct position of the ISOL-GND front panel switch.
9. **HARMONIC DISTORTION** less than 0.5% and amplitude linearity is ±1% of best straight line.
10. **POWER —** Individual power supplies in each module; double-shielded power transformer; 100-130 V AC or 200/260 V AC; 50/60 Hz; 5 VA consumption.
11. **FRONT PANEL CONTROLS**
    - 11.1 Full Scale Range Switch
    - 11.2 Mode Switch-Test; V-Cal; Oper; F-Cal
    - 11.3 Sensitivity Dial (10 Turn locking)
    - 11.4 Sensitivity Range Switch 1-10, 10-100
    - 11.5 Case Switch — Isol; Gnd. (Range Pilot)
    - 11.6 Preamplifier Switch — Remote; Internal
    - 11.7 Tape Gain Dial (10-turn locking)
12. **PHYSICAL**
    - 12.1 Single Module Standard — 2.8 W × 5.25 H × 19 D — requires Model 22RA Rack Adapter for multichannel mounting of up to six channels.
      Rack Adapter 22RA: 19 W × 5.25 H × 21 D (6 modules)
    - 12.2 Single Module "–8" Option — 2.8 W × 8.75 H × 19 D — requires Model 22RA-8 Rack Adapter for multichannel mounting of up to six channels.
    - 12.3 Connectors are all coaxial BNC except for:
      Oscillator phone jack — mating connector supplied
    - 12.4 Weight: Single module — nominal 6 pounds
    - 12.5 Operating Temperature: 40°F to 125°F



22RA RACK ADAPTER



22RA-8 RACK ADAPTER

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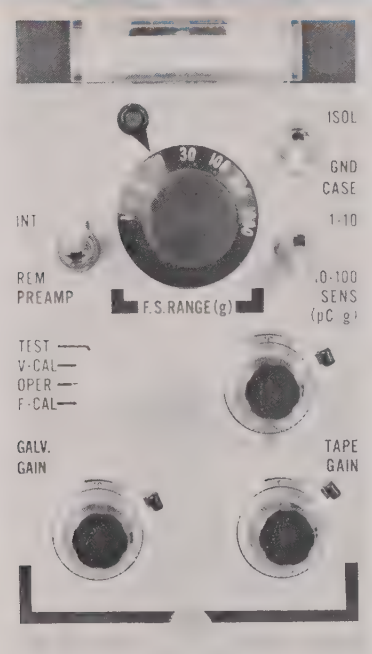

Model D22 PMGL

MODEL D22 SERIES CHARGE AMPLIFIERS

WITH INTEGRAL LOG DC CONVERSION

Log plots of acceleration versus frequency can be obtained using a D22 Series Signal Conditioning Amplifier with the "L" Log DC option. A signal conditioning channel with the Log DC feature, plus an appropriate DC frequency signal, will allow X-Y plotting of vibration test sequences such as covered by typical MIL specs (see Figure 1).

The Log DC feature is offered along with many other popular Series 22 options, including 10 mV/g servo output, independent galvo output, and automatic or remote ranging.

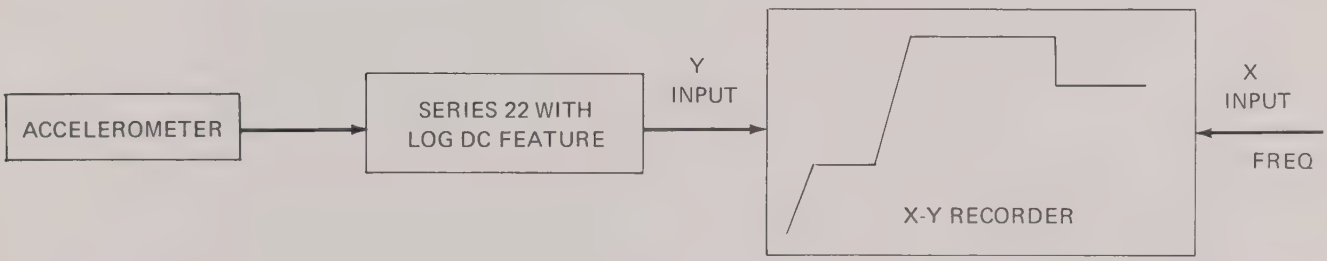

FIGURE 1 - Single Channel Used For Recording Typical Vibration Test (Accel vs Freq)

PLOT TRANSMISSIBILITY WITH 120 dB DYNAMIC RANGE

The ratio of two acceleration signals can be plotted by simply connecting the Log DC outputs of two Series 22 instruments to the differential input of an X-Y recorder as shown in Figure 2. This arrangement permits the plotting of transmissibility, apparent mass, and impedance directly from the appropriate transducers, or from previously recorded data played back on magnetic tape. A special averaging technique provides a full 120 dB dynamic range from two 60 dB instruments. By using a constant amplitude servo controller (U-D Model SP Series) in conjunction with the Unholtz-Dickie MAC-8 Multifunction Averaging Control, the average test level of two control points can be held constant. It can be shown algebraically (see Table A) that under such conditions, the maximum acceleration level at either control point will never exceed twice the control level set on the servo. This constraint allows the test engineer to select a full scale range on each Series 22 signal conditioner just great enough to handle twice the servo setting. In the example covered by Table A, a 10 g full scale setting on each instrument would allow a 120 dB variation in transmissibility, while still remaining within the 60 dB dynamic range of each signal conditioner.

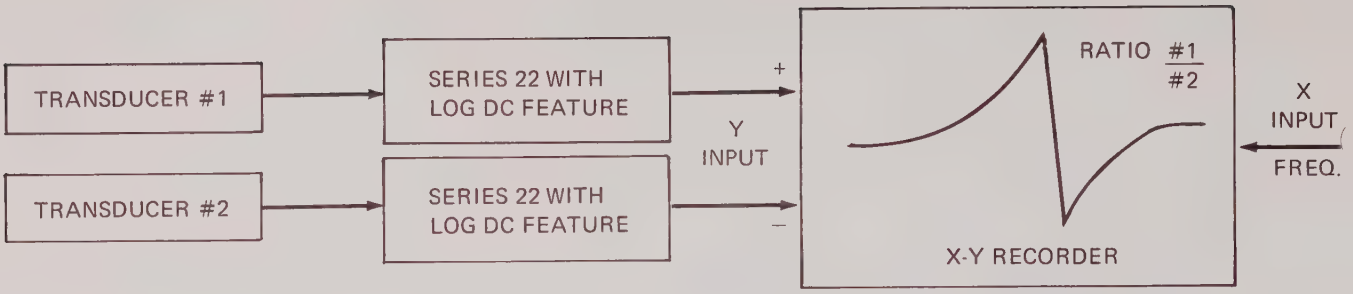

FIGURE 2 - Two Channels Used For Recording Transmissibility, Apparent Mass, or Mechanical Impedance

TRANSMISSIBILITY T	AVERAGE CONTROL LEVEL $\frac{A_1+A_2}{2} = \frac{A_1+TA_1}{2} = 5g$	ACCELERATION A_1	ACCELERATION $A_2 = TA_1$
1	$\frac{2A_1}{2} = 5g$	5g	5g
10	$\frac{11A_1}{2} = 5g$	.91g	9.1g
100	$\frac{101A_1}{2} = 5g$	.099g	9.9g
1000	$\frac{1001A_1}{2} = 5g$	.01g	10g
.1	$\frac{1.1A_1}{2} = 5g$	9.1g	.91g
.01	$\frac{1.01A_1}{2} = 5g$	9.9g	.099g
.001	$\frac{1.001A_1}{2} = 5g$	10g	.01g

TABLE A

SPECIFICATIONS — OPTION "L" (LOG DC OUTPUT)

OUTPUT SIGNAL:	Single ended DC output proportional to the logarithm of the average value of the AC input.
OUTPUT SENSITIVITY:	+1V/decade, O V DC corresponds to full scale sinusoidal inputs.
OUTPUT IMPEDANCE:	Less than 50 ohms
CONVERSION ACCURACY:	±0.2 dB from 0 to -40 dB and ±0.5 dB at -60 dB, over a temperature range of 20°C to 50°C.
FREQUENCY RESPONSE:	Flat within ±0.5 dB from 5 Hz to 10 kHz
DYNAMIC RANGE:	60 dB
SPAN:	Upper limit of the 60 dB span corresponds to 100% meter deflection and is selected by the full scale range switch.

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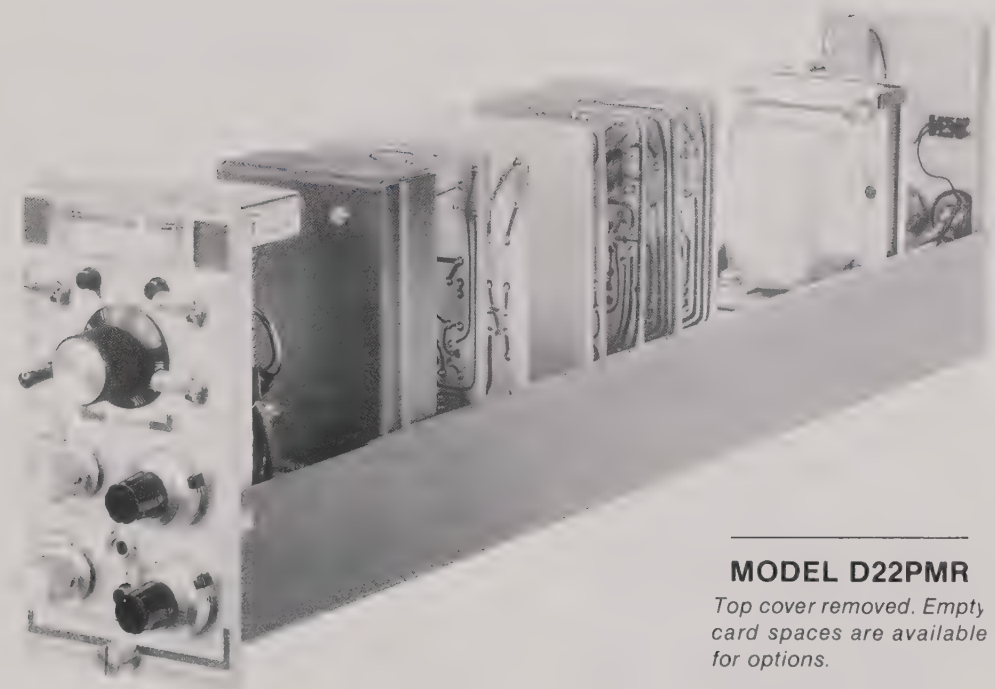
UNHOLTZ-DICKIE CORPORATION

VIBRATION TEST EQUIPMENT

Model D22 Series

OPTION DESCRIPTIONS



MODEL D22PMR

Top cover removed. Empty card spaces are available for options.

The printed-circuit plug-in card construction of the D22 Series enhances the versatility of the instrument line. A large number of options are available. A description of each option is given below, except for the External Range Control (E) and Autoranger (A) options, which are found on a separate bulletin. If the standard options described in this brochure do not meet your specific needs, U-D welcomes the opportunity to make proposals to meet special customer requirements. Usually an 18 to 24 channel minimum requirement is necessary to provide an economically attractive quotation for non-standard configurations.

Servo Output (S)

The servo (acceleration) output has a 10 mV/g sensitivity which is independent of the range switch setting. Output impedance is less than 50 ohms, and a maximum of ±10V at ±10 mA is available on at least one range with never less than ±1V available on all ranges (100 g). Standard frequency response is flat within ±2% to 5 kHz and 3 dB down at 10 kHz unless otherwise specified. Available for all D22 Series instruments.

Extended Servo Output (J)

By means of a 3-position toggle switch, the servo output can provide a sensitivity of 1, 10 or 100 mV/g independent of range switch setting. Other specifications are identical to that of the "S" option. The switch is located on the front panel for the D22PMJ, and on the rear panel for the D22PMHJ and D22PMRJ.

Calibration Oscillator (O)

The internal oscillator provides 100 mV peak ±1% at 100 Hz ±5%. When the D22 is placed in any one of the calibration modes (TEST, V-CAL, or F-CAL) the oscillator voltage is applied automatically to the circuit. By means of a rear panel phone jack, the insertion of an external oscillator voltage automatically disconnects the internal oscillator. One calibration oscillator for each six D22 instruments (a full complement for a rack adapter) is sufficient since the output from one internal oscillator may be patched to the other five instruments. Available for all D22 Series instruments.

Linear DC Output (F)

The linear DC (acceleration) option provides a rear chassis BNC connector with 10V DC at the full scale condition selected on the front panel range switch. Linearity is ±1/4% of F.S. and 50 dB dynamic range is specified. Available for all D22 Series instruments.

Logarithmic DC Output (L)

A sensitivity of −1V per 20 dB of input change is provided, and 0V DC output corresponds to full scale sinusoidal inputs. A dynamic range of 60 dB is supplied with a stability and accuracy of ±0.2 dB from 0 to -40 dB and ±0.5 dB at -60 dB over a temperature range of 20° to 50° C. Averaging and conversion speed is dependent on the AC-DC converter associated with the meter feature, which is standard. Operation down to 5 Hz is a minimum requirement.

The log DC outputs from two D22 Series instruments can be used with the differential Y input of an X-Y recorder to provide plots of transmissibility, apparent mass, or mechanical impedance if the appropriate transducers are used. A full output range of 120 dB can be obtained from two 60 dB instruments by using an averaging instrument (UD Model MAC-8) and a servo controller (UD Model SP Series). The combination maintains the average of the two variables at a constant value, but lets both instrument outputs fluctuate and yet never lets either output exceed twice the average control level. It is possible for both outputs to use the full 60 dB range and their ratio to have a maximum 120 dB range. Available for all D22 Series instruments.

High-Current Line Driver (C)

The line driver has a capability of ±10V or ±100 mA, whichever is limiting, to frequencies of 20 kHz. Capacitive loads may be driven under these limitations without causing oscillations. The frequency response is identical to that for the instrument. The output impedance is less than 0.2 ohm + .05 ohm/kHz. This output may be supplied at a fixed voltage for full-scale inputs, or may be coupled with the TAPE GAIN potentiometer for an adjustable full-scale output. Available for all D22 Series instruments.

Galvanometer Driver (G)

The galvanometer driver is identical to the High-Current Line Driver (C) except that a separately-adjustable 10-turn potentiometer and locking dial is supplied on the front panel to provide a calibrated full-scale output. Available for D22PM only.

Tracking Filter (T)

By means of two rear panel BNC connectors, the signal from the D22 may be fed through a unity-gain tracking filter (UD Model TF22) and back into the D22 so that the D22 outputs (tape; meter; servo; high-current) represent the narrow-band signal. In this way, servo control can be obtained from the fundamental sine component, and the meter indication of the D22 can be used without purchasing additional meters. Removal of the tracking filter from the rear panel connectors requires a short patch cable which is supplied with the instrument option. Not available for D22PMB.

Velocity Output (I)

The velocity output has an adjustable sensitivity from 100 to 110 mV-sec/in. Two pole high-pass filtering is built into the velocity integrator circuit to provide a flat frequency response ±2% from 5 Hz to 5 kHz and 3 dB (typ) down at 2.5 Hz. Output impedance is less than 50 ohms and maximum output capability is ±10V at ±10 mA. The servo (S) option is required also. Not available for D22PMB.

Displacement Output (II)

The displacement output has a sensitivity of 1V/in. D.A. Two-pole high-pass filtering is built into the displacement circuit also. A flat frequency response ±3% at 5 Hz, ±2% 10 to 500 Hz, and 6 dB down at 2.5 Hz is provided. Output impedance is less than 50 ohms and maximum output capability is ±10V at ±10 mA. The servo (S) and velocity (I) options are also required. Not available for D22PMB.

Single-Ended High-Temperature Input (K)

The option provides a modification on the D22 charge converter so that single-ended inputs from high-temperature accelerometers may be accepted without causing blocking for input shunt resistances as low as 10 kilohms. A D22 input connector is provided which is compatible with a differential accelerometer cable.

Source capacitances of 20,000 pF will cause less than 1% gain change for transducer sensitivities from 1-100 pC/g. The frequency response at 5 Hz is flat ±5% with 50 kilohm shunt resistance. The

acceleration noise with a 20 Hz (±2% and -3 dB at 10 Hz) high-pass filter is less than 0.05 pC rms referred to the input.

High pass filter frequency should be specified by customer when ordering K option.
Not applicable for D22PMB.

Large Meter (-8)

A 2.5 in. scale meter is provided with a knife-edge needle for easier reading. Accuracy is ±2% of full scale. The panel height is 8.75 inches and the modules use the Model 22RA-8 Rack Adapter. Not available for D22PMH or D22PMB. See adjacent figure.

The following optional features (-2, -3, -4) can only be supplied with orders of 12 or more instruments and are not available with the D22PMB.

Extended Low Frequency Response (-2)

This option provides the following low-frequency response for charge inputs (strain-gage inputs where applicable) at the servo, tape, high-current and meter outputs.

flat ±2% at 2 Hz
±5% at 0.5 Hz

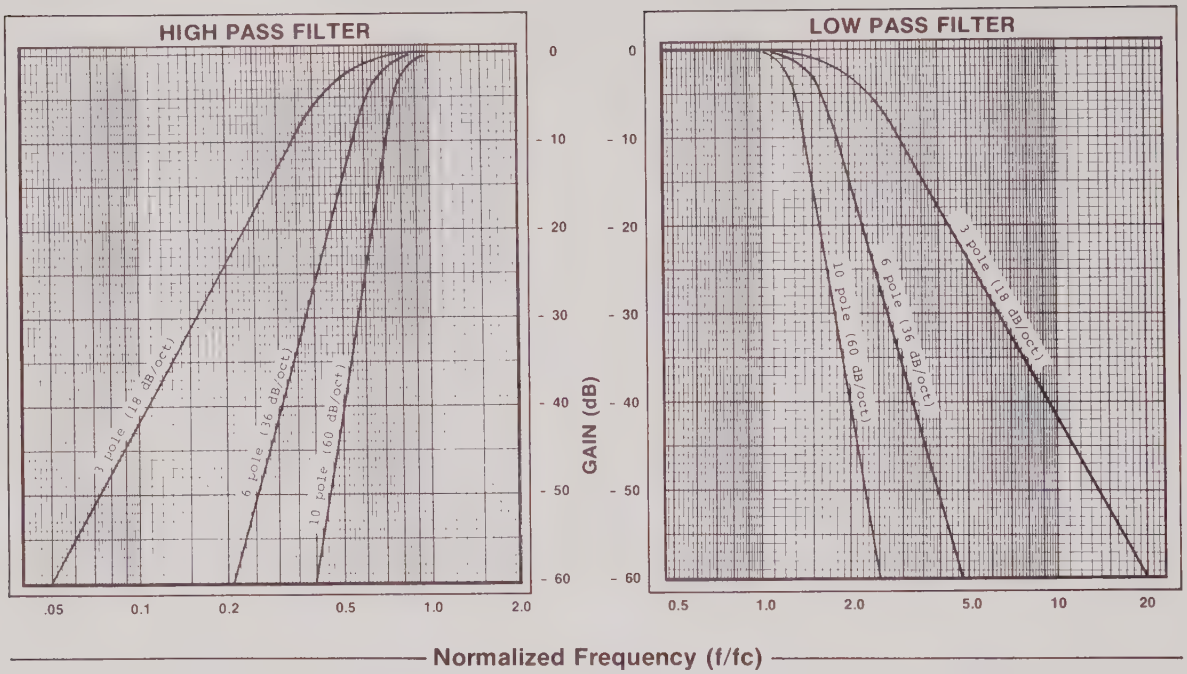
Additional X10 Gain (-3)

The gain is ten times that of the standard instrument (not available for D22PMR). Standard range switching with this option provides full scale ranges from 0.1 g to 1000 g for transducers with sensitivities from 1-100 pC/g. Note that a transducer with a sensitivity from 10-100 can be used on the 1-10 sensitivity range, thus providing full scale indication for inputs as low as .01 g. Nominal maximum instrument gain is 100,000 mV/pC.

Full Scale Relay Calibration (-4)

Application of the relay control signal (+15V at 15 mA) to the rear-panel BNC connector causes full scale indication at the meter, tape, and high-current outputs, regardless of the range and sensitivity settings, if 100 mV peak is applied to the oscillator jack. This option quite logically accompanies the internal oscillator (O) option, whereupon triggering the relay causes full-scale output. The relay actuation overrides the mode provided by the manual mode switch.

Model D22PMG-8
(actual size)



Filter Frequency Response Curves

Shown above are normalized frequency response curves describing the high-pass and low-pass filter characteristics available for the D22PMH. The 3-pole filters are standard for the D22PMH and the 6 and 10 pole filters may be obtained at increased cost. Response specifications for each filter type are found in the table below. Response is nominally Butterworth.

		High Pass Poles			Low Pass Poles		
		3	6	10	3	6	10
Response	± 2%	1.0	1.0	1.0	1.0	1.0	1.0
	-3 ± 1 dB	0.5	.67	.78	2.0	1.5	1.28
	< -20 dB	.22	.44	.62	4.6	2.3	1.60

Normalized Frequency (f/fc)

The standard low-pass filters in the Model D22PM, D22PMR and D22PMB have the frequency response characteristics for the 3-pole low-pass section in the table above.

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WARRANTY

Digital controllers and associated options are warranted to be free of defects in material and workmanship for a period of 90 days from date of shipment (Extended Coverage available).

All other products are warranted to be free of defects in material and workmanship for a period of one year from date of shipment. If the products are not installed, maintained and used in a normal manner in accordance with instructions and manuals, this warranty will not apply.

This warranty is limited to repairing and replacing parts which have been returned to UNHOLTZ-DICKIE CORP., and in our opinion are defective. Service required to correct defects in material or workmanship will be supplied without charges. The Buyer will pay all transportation and taxes incurred. This warranty does not cover costs incurred by the Buyer as a result of purchase of UNHOLTZ-DICKIE CORP. equipment or any charges for the Buyer's labor for replacement, adjustment or repair unless authorized in advance in writing. We are not liable for consequential damages.

This warranty will not apply to any products which, in the opinion of UNHOLTZ-DICKIE CORP., have been subject to accident, misuse or neglect; altered or repaired with a substitute which might impair the product; or used outside of rated conditions. UNHOLTZ-DICKIE CORP. reserves the right to make improvements in its products including changes and additions without incurring obligations to incorporate such improvements in previous units.

This warranty is expressly in lieu of any and all other warranties or commitments, expressed or implied and any other obligations to the Buyer associated with the use of UNHOLTZ-DICKIE CORP. products.

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Incoming Instrument Inspection and Return Shipping Instructions

1. Unpacking and Inspection

If the shipping carton is damaged, note on acceptance that it is received damaged and subject to claim when inspected. Ask that the carrier's agent be present when the instrument is unpacked and inspected for damage (scratches, dents, broken knobs, etc.). If the instrument is damaged or fails to meet specifications, notify the carrier and the Unholtz-Dickie Corporation immediately. Retain the shipping carton and the padding material for possible return for repair or further inspection by carrier. The purchaser and Unholtz-Dickie Corporation will arrange for the replacement and/or repair of the damaged item.

Refer to our separate warranty page for a statement of our warranty policy.

2. Return Shipment

Return shipment procedure: Please be sure the following instructions are observed if a Model 22 Series instrument is being shipped back to Unholtz-Dickie for repair, replacement, or upon completion of use as a demonstrator or loaner.

2.1 Size of Box and Packing Instructions

2.1.1 Single Channel with 5¼ inch Panel Height

If the single channel was shipped from Unholtz-Dickie as an individual unit, replace the instrument in its original container. If the instrument was shipped as part of a rack mounted combination of channels, the single channel can be returned separately in a container that is no smaller than 22½ inch x 10½ inch x 9½ inch. The front and rear panels must be completely protected by approximately 2 inches of cushioning material. The top, bottom and sides must be surrounded by cushioning and filler materials. A strong, double wall type corrugated box, (350 lb/sq. in. minimum bursting test) has been proven to give adequate service. DO NOT USE A SMALLER OR WEAKER CONTAINER THAN THAT RECOMMENDED ABOVE.

Cover the painted surfaces of the instrument with protective wrapping paper or a plastic bag whenever the packing material might be coarse enough to scratch the painted surfaces.

2.1.2 Six Channel Rack with 5¼ inch Panel Height

CAUTION: Do not rest the rack type instrument in a vertical position with its weight on the rear since the connectors and switches at the rear of the instrument might be damaged.

Replace this instrument in the original container. Replace all packing pads and fillers in the exact position which they originally occupied. If the original container is no longer available, use a container that is no smaller than 27 inch x 20½ inch x 10½ inch.

It is important that protection be provided for the rear connectors and switches during shipment. A sheet of stiff cardboard should be placed under the instrument and then folded up to meet the top of the rear panel. The instrument should be bagged and surrounded on all surfaces by cushioning and filler materials. A strong, double wall type corrugated box (350 lb/sq. in. minimum bursting test) has been proven to give adequate service. DO NOT USE A SMALLER OR WEAKER CONTAINER THAN THAT RECOMMENDED ABOVE.

2.1.3 Single Channel with 8-3/4 inch Panel Height

Follow the instructions given in paragraph 2.1.1, except that extra precautions must be taken to prevent the front panel extension with its meter from being bent during shipment. The extended meter must be braced between packing material so that the load force will be distributed evenly over the entire front panel of the instrument.

2.1.4 Six Channel Rack with 8-3/4 inch Panel Height

Follow the instructions given in paragraph 2.1.2, except that the container size must be no smaller than 26½ inch x 25 inch x 13½ inch.

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MA34548

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